Electrical Review
WITH WHICH IS CONSOLIDATED WESTERN ELECTRICIAN AND ELECTROCRAFT.

Vol. 72.—No. 23. CHICAGO, SATURDAY, JUNE 8, 1918. Page 941.

Electric Furnace for Forging and Annealing of Steel

Development of Furnaces for These Purposes Using Silicon Carbide as Resistors—Abstracted from a Paper Read Before the Association of Iron and Steel Electrical Engineers

By WIRT S. SCOTT

Commercial Engineer, Westinghouse Electric & Manufacturing Company.

OUR experimental work on resistor-type furnaces for forging has continued through several years. Our first investigation was with a granular-graphite resistor bed. Other resistor materials and various combinations of materials, consisting of granular graphite, coke, charcoal, and finally these materials in various combinations, also in combination with carbon blocks, were given exhaustive tests, always with the same general results. It is sometimes of equal importance to know the reasons for failures as it is to know the reasons for success, hence it should be of interest to know the reasons for discarding all of the above resistor materials as being unsuitable for an electric forging furnace.

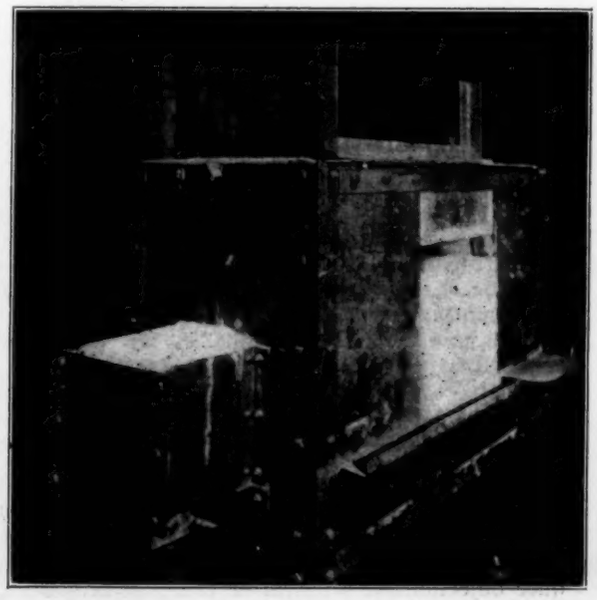
Objections to Using Carbon as Resistor.

To secure even moderately successful results, it was found that resistor material must be of the purest carbon or graphite. It is quite difficult to obtain a supply sufficient for operating furnaces. If there is any slag or ashes left from the combustion of the resistor, it remains in the bed so that the relative proportion of such material is gradually increasing with time, causing an increase in the resistance of the furnace.

If the slag or ash is fusible at the temperature of the resistor bed, a clinker will be formed which very rapidly extends through the granular mass, resulting in a rapid increase in resistance and consequent failure to heat.

When the furnace was maintained for a considerable length of time at sufficiently high temperature to turn out heated steel at 1800 degrees Fahrenheit, we found that the temperature in the bottom of the resistor bed exceeded the safe limits of refractory materials. With a temperature of 1800 degrees on the sur-

A 15-Kilowatt Double-Opening Forging Furnace With Preheating Chamber.



A 20-Kilowatt, Single-Opening Forging Furnace With Preheating Chamber.

face of the bed, it was found that the temperature at the bottom was approximately 3600 degrees. This great temperature difference is due to the electrical characteristics of carbon in that it has a large negative temperature-resistance co-efficient, that is, as the temperature increases the resistance decreases. It is evident that the carbon in the bottom or at the center of the bed will operate at higher temperatures than the surface, which has an opportunity to radiate its heat to the surrounding air and chamber. An increase in temperature at any given part lowers the resistance through that part, which in turn causes more current to flow, and so on, the temperature gradually increasing with the current. Conditions tend to become stable at a very high temperature, but greatly in excess of that which may be safely withstood by any refractory material now available.

In heating a piece of work in an ordinary fuel-fired furnace, heat is transferred to the work by conduction from the hot gases and by radiation from the walls. The walls are maintained at a temperature higher than that desired at the work because they are continuously swept by the hot gases. In an electric furnace we do not have this action to heat all of the surface uniformly. If heat is generated only on the floor of the hearth, the side walls and roof must obtain their heat by direct radiation. If cold pieces of metal are laid closely over the surface of the resistor hearth, they will interfere with the radiation of the heat to the walls and roof directly in proportion to the amount of hearth surface they cover. This would mean that the work would be heated from the under side only, and instead of receiving heat from the walls and roof, it would be giving off heat, thereby always having a great difference in the temperature on the two opposite sides. In order to heat the upper surface to a sufficiently high temperature, the lower surface must be overheated.

Characteristics of Silicon Carbide as a Resistor Material.

During the latter part of 1916 we began our experiments in using carbide as a resistance material. A study of the chemical and physical properties of silicon carbide led us to believe that it possessed desirable qualities essential to a suitable resistor for an electric forging furnace, but also indicated that there were many difficulties to be overcome which were real problems in themselves.

The temperature of formation of this resistor is 1950 degrees centigrade (3542 Fahrenheit).

The temperature of decomposition is 2220 degrees centigrade or 4018 Fahrenheit.

There is no oxidation of this material in pure oxygen at 1000 degrees centigrade. From 1500 to 1800 degrees centigrade oxidation is very much retarded by the fused silica coating. Neutral or reducing gases, such as carbon monoxide, nitrogen and hydrogen, have little or no action.

The hardness is between that of the ruby and the diamond.

Specific gravity is 3.12 to 3.20. Based on a specific gravity of 3.20, the weight of the solid block without pores is 199.7 pounds per cubic foot, or 0.116 pound per cubic inch.

Tensile Strength.—In order to adapt silicon carbide to its various uses, the tensile strength of the bonded articles may be made to vary between wide limits. In ceramic bonded articles where the bond does not introduce objectionable physical or chemical properties, a tensile strength of 1400 pounds per square inch may be attained. A sacrifice of resistance to heat changes and chemical actions affecting ceramic articles must be expected with high tensile strength.

Electrical Conductivity.—This resistor is a conductor of the second class. At ordinary temperature its conductivity is very low, being several times less than that of carbon. With increase of temperature its conductivity increases very rapidly, as it has a large negative temperature-resistance co-efficient.

The resistivity of the bricks varies with differences in porosity and chemical composition. However, it is interesting to note that at temperatures above 1800 degrees Fahrenheit the resistivities have approximately the same value. A general idea of the variation of the resistance will be obtained from the following:

75 degrees Fahrenheit.....	50	ohms per cubic centimeter
1000 degrees Fahrenheit.....	18	ohms per cubic centimeter
1800 degrees Fahrenheit.....	3.7	ohms per cubic centimeter
2550 degrees Fahrenheit.....	0.65	ohms per cubic centimeter

From a resume of the above, it may be seen that this resistor material possesses the following excellent qualities.

(1) The temperature of decomposition is above 4000 degrees Fahrenheit, which is approximately 1500 degrees higher than the hottest temperature required at the surface of the resistor. Due to the construction of furnace employed, the atmosphere in the furnace chamber is non-oxidizing, and under these conditions the resistor is non-consuming.

(2) May be molded in block form, allowing the heating element to be placed in any desirable position around the heating chamber.

(3) Due to its high tensile strength, the roof of the heating chamber as well as the hearth may be made out of these resistor blocks.

(4) The fact that it has a large negative temperature-resistance co-efficient may be utilized in the control of the furnace temperature by controlling the current input to this resistor material.

Experiences with Early Furnaces of This Type.

The first complete furnace of this type which we built and which gave promise of success was designed with two working chambers 7 inches long by 5 inches high, for the heating of 50 pounds of steel per hour to 1800 degrees Fahrenheit in each chamber, or a total of 100 pounds per hour for the furnace. The resistors consisted of blocks having a cross section of 4½ inches by 2½ inches, passing above and below the working chamber. The resistors terminated in electrode chimneys filled with granular graphite, into which steel terminal plates extended for external connections.

Owing to the high resistance of this type of furnace when cold, and due to the length of resistors used, a starting voltage of 220 volts was required, which was cut down in a few minutes' time to 110 volts, and then gradually reduced until 60 volts was reached, which maintained the proper temperature.

The time required to bring the furnace up to an operating temperature of 1800 degrees was 8 hours, starting with the furnace cold. Owing to the great heat-reserve capacity of the furnace, the times required in successive heatings were greatly reduced; this depended upon the length of time the furnace was out of operation. In order to have the furnace available for immediate use, sufficient current was maintained on the furnace during the nights to supply the radiation losses. On a 20-hours continuous forging test the average input was about 18 kilowatts, or 300 amperes at 60 volts. The hourly output averaged 20 pounds, heated from 70 to 1800 degrees Fahrenheit, and 40 pounds from 900 to 1800 degrees.

Notwithstanding the light insulation that was used, a furnace efficiency of 41 per cent was maintained. The furnace ultimately proved unsatisfatcory due to unequal heating of the two chambers.

The results of the tests proved conclusively that a temperature of 1800 degrees Fahrenheit could be obtained and maintained for an indefinite period so far as the resistor material was concerned. Hand control was used entirely in the operation of this furnace, in conjunction with a circuit-breaker for tripping the circuit should the current increase beyond a safe operating value.

The second complete furnace had an over-all dimension of 46 inches wide, 38 inches deep by 48 inches high, inclusive of an iron stand 12 inches high. The resistor consisted of two blocks 2½ by 4½ inches cross section by 9 inches in length, connected in parallel, one over the heating chamber and one underneath, 2½ inches apart, forming a heating chamber 7 inches wide, 11 inches deep by 2½ inches high. The resistors were surrounded and imbedded in a refractory lining made up principally of a crucible clay and a graphite mixture. Surrounding this extremely hot area silica bricks were used backed up by ordinary fire bricks.

Electrode chimneys or wells were used very much the same as with the first furnace. The electrodes consisted of granular graphite and an amorphous carbon rod 4 inches square by 20 inches long imbedded in each electrode well, and extending upward from near the steel terminal plate at the bottom of each well to the ends of the two resistors. The granular graphite insures electrical contact between the resistor blocks and the carbon block, and between the carbon block and the terminal plate. A cool terminal is thus obtained.

The heat insulation on the outside of the furnace consisted of 4½ inches of high-grade insulating brick all around, except opposite the electrode wells and around the door. Thin sheet steel held in place by angle iron and tie rods clamped the insulating bricks together.

The starting voltage on this furnace was 75 volts, and the time required to raise the temperature of the heating chamber to a forging temperature of 1800 degrees Fahrenheit was two hours. The power required at full load was 10 kilowatts or approximately 300 amperes at 33 volts. At no load, a consumption of 5 kilowatts or 200 amperes at 25 volts obtained. This corresponds to an efficiency of 50 per cent.

The longest continuous run extended over a period of 15 days, or 370 hours, the furnace being maintained continuously at a forging temperature of 1800 degrees. After these tests an examination of the resistors was made, but no perceptible effect due to heating could be determined.

The control equipment consisted of a 110-volt transformer with knife switches for obtaining starting voltage, and interlocked magnet switches, push-button operated, for obtaining the required running voltage. A circuit-breaker was used as in the first case for protecting the furnace against an increase in current above the safe operating value.

First Furnaces for Continuous Use Under Shop Conditions.

The first furnace to be placed in continuous operation under actual shop conditions was made early in 1917. This furnace, a duplicate of the one last described, was installed in the tool forging shop of the Westinghouse Electric & Manufacturing Company, and while it was considered that the furnace was still in its experimental stages, it was essential that we gain the experience of knowing how it would stand up under regular shop conditions. Several failures of the furnace were recorded, but in each case the failure was due to the improper functioning of the control equipment which we were developing and experimenting with at that time.

This furnace has been in operation for a period of one year, with highly encouraging results. Many runs have been made of continuous operation for periods of 400 to 500 hours, forging high-speed steel to 1850 degrees Fahrenheit, and drop forging at 2200 degrees without any records of resistor failure, or any perceptible deterioration in the resistor due to the high operating temperature. One run of 500 hours was made at a temperature of 2650 degrees without experiencing any difficulty whatever.

For high-speed steel work, it was found advisable to preheat it before being placed in the heating chamber. A preheating chamber was constructed under the heating chamber, consisting of an opening in the front of the furnace just below the lower resistor, into which the tools could be placed for preheating to eliminate strains that otherwise would be set up in the steel when placed in the furnace.

Another furnace has been built and placed in operation at our works, having a heating chamber 18 inches wide, 12 inches deep and 4½ inches high. The capacity of this furnace is 20 kilowatts, the starting voltage 220, and the running voltage 70. The efficiency is 60 per cent. This furnace is designed to operate on steel drop forgings requiring a temperature of 2300 degrees Fahrenheit.

The control equipment at the present time is not completely automatic. That is to say, the furnace is not automatically brought up to the required temperature, but once the required temperature is obtained, then the control equipment will maintain that temperature within certain limits. Interlocked knife switches are used for connecting to the starting taps on the transformer. As the furnace increases in temperature it is necessary to step down to lower voltages. The lower-voltage taps are controlled by means of magnet switches operating over a relatively small percentage of the voltage range in order to obtain close temperature regulation.

The control equipment thus far developed is semi-automatic in its action, and may be used with entire satisfaction where the operator has a proper appreciation of the functioning of the control equipments. However, it is our intention to ultimately develop a complete automatic control equipment, which we hope to have perfected at an early date.

Advantages of the Electric Over Fuel-Fired Furnaces.

The general type of the furnace such as we have developed has a very wide application, but our experiments thus far have been largely confined to forging, vitreous enameling, and for the reheating of glassware. A special furnace has been constructed and is successfully operated for the forming of lamp chimneys.

Forging requires an operating temperature of from 1800 to 2300 degrees Fahrenheit, depending upon the kind of steel used. Our great difficulty with a fuel-fired furnace is not in the ability to obtain a sufficiently high heat, but in uneven heating. It is almost impossible to obtain uniform temperature throughout the entire chambers; consequently when the furnace is operated on a production basis, with several pieces being heated at one time, some of the pieces of work

will be much hotter than others. The pieces in the hottest portion in all probability will heat much too rapidly, with the result that either the corners of the tools are burned before the material is heated clear through, or if it is removed before the surface burns, the center has not reached a sufficiently high temperature. In this case the soft outside will yield much more readily than the hard inside, with the result that the outer particles will be torn asunder while the inside will be sound. The loss through oxidation takes place while the work is being heated in a fuel-fired furnace and also after it has been withdrawn and is being forged. The oxidation in the furnace is by far the larger of the two.

Superiority of the Electric Furnace for Annealing of Steel.

Annealing or softening is accomplished by heating steel to a red heat ranging from 1300 to 1600 degrees Fahrenheit, depending upon the grade of steel, and then cooling it slowly. If the temperature is carried too high, it may leave the steel actually harder than the proper heat would leave it, besides running the risk of forming scale. If scale is raised on a piece of steel, this scale will be a granular oxide of iron and may spoil the tools used to cut it, sometimes also changing the structure of the steel, making it brittle and causing it to crack in hardening. The effect of heat on steel may be noted by taking a bar of steel nicked in 10 or 12 places about ½ inch apart, heating it in a fuel-fired furnace until the end is up to a good white heat, and then plunging it into cold water. In breaking off the pieces at each nick, it will be seen that characteristic changes have taken place in the steel. The end of the rod which had been overheated will be very open or crystalline in structure, the succeeding pieces becoming closer and closer in grain until one piece is formed possessing a close, even grain, the structure desired.

For every variation in the temperature there is a variation in grain of the steel. The effect of too high a heat is to open the grain, to make the steel coarse. The effect of irregular heat is to cause irregular grain, irregular strains and cracks in the steel.

The furnace described offers an ideal solution for the conditions as above outlined, because:

(A) Uniform temperature is obtained in all parts of the heating chambers.

(B) The temperature found to produce the most satisfactory results may be obtained and maintained indefinitely.

(C) A neutral atmosphere is obtained in the furnace chamber, thereby eliminating the major part of the oxidation of the steel.

For a given class of work subjected to a given heating operation the following conditions must apply.

1. The rate at which the work is heated is capable of infinite variation, but there must be some best sequence of heating.

2. The temperature difference between the heating medium and the work may be almost any value, but there must be some best value.

3. The maximum temperature to which the work is heated may be almost any value but there must be some best maximum temperature for each grade of steel.

An electric furnace permits of doing such experimental work as will exactly determine these factors and, once they have been determined, it permits an operator to duplicate these results in operation—the ultimate feature in which we are interested.

COMPETITIVE EXAMINATION FOR RADIO INSPECTOR.

The United States Civil Service Commission announces an open competitive examination for radio inspector, for men only. Vacancies in the positions of radio inspector and assistant radio inspector, at entrance salaries ranging from $1200 to $1600 a year, depending upon the qualifications of the appointee, in the offices of the radio inspectors of the Bureau of Navigation, Department of Commerce, in Washington, D. C., and throughout the United States, will be filled from this examination, unless it is found in the interest of the service to fill any vacancy by reinstatement, transfer, or promotion.

The duties of radio inspectors will be primarily to inspect the radio apparatus on steamships, to insure its compliance with the law, and to inspect shore stations. The inspectors may also be called upon to inspect radio operators. The duties of radio inspectors require some office experience, therefore competitors should outline fully in their applications any office experience they may have had.

The duties of assistant radio inspectors will be primarily the assisting of radio inspectors in the enforcement of the wireless communication laws. Assistant radio inspectors will be required to inspect the radio equipment on board vessels and in land stations, which involves the carrying of 30 or 40 pounds of testing and measuring instruments. The inspection work requires a knowledge of the installation and operation of the several types of radio installations, including the adjustment and tuning of transmitters and receivers.

Applicants must have had the training and experience specified in one of the following groups:

(a) The completion of at least 7 units of high-school work (usual two years), and in addition not less than two years' experience in special radio work such as the manufacture, installation, or adjustment of commercial or governmental wireless apparatus.

(b) The education called for under (a) and one year as a paid wireless operator, and one year in special radio work such as the manufacture, installation, or adjustment of commercial or governmental wireless apparatus.

(c) At least a senior student in a college or university of recognized standing, having pursued for three years a scientific course of study including radio and kindred sciences, such senior students being admitted to the examination subject to their furnishing proof of actual graduation within three months from the date of making oath to the application.

Applicants must have reached their twentieth birthday on the date of making oath to the application. Applicants must submit with their applications their photographs, taken within two years, with their names written thereon. Tintype or proofs will not be accepted.

Applicants will be admitted to this examination regardless of their residence and domicile; but only those who have been actually domiciled in the state or territory in which they reside for at least one year previous to the date of making oath to the application, and who have the county officer's certificate in the application form executed, may become eligible for permanent appointment to the apportioned service in Washington, D. C.

On account of the urgent needs of the service, applications will be received until further notice. Papers will be rated promptly and certification made as the needs of the service require.

Sag-Temperature Calculations of Transmission Lines on Steep Grades

Practical Examples of the Application of Formulas to Ordinary Conditions —From a Paper Before Franklin Institute Describing Methods of Solution

By ALFRED STILL

Professor of Electrical Engineering, Purdue University.

THE men engaged in the erection of overhead electric power transmission lines should be provided with tables or charts giving the sag or tension at different temperatures for a given length of span. This enables them to string the wires—either by sighting from pole to pole when erecting to the required sag, or by using a dynamometer when erecting to the required tension—so that the stress shall not exceed the specified limit under the weather conditions which will produce the assumed maximum loading.

If the storm conditions are such as to produce in the wire a stress n times as great as the stress when the wire hangs in still air at the same temperature under the influence of gravity only, there will be a reduction in length due to elastic contraction when this extra load is removed, and the maximum deflection from the straight line joining the points of support will now be less than under storm conditions. It should, however, be observed that, with a sufficient rise of temperature, the elongation of the wire will be such as to produce the same maximum deflection notwithstanding a reduction in the tension. This particular temperature—which may be called the "critical" temperature—is very easily calculated,[1] and since the relation between the sag and tension is expressed by the well-known formula,

$$s = \frac{wl^2}{8P} \qquad (1)$$

it follows that, if s (the sag) and l (the span) remain constant, we obtain the relation

$$\frac{nw}{P} = \frac{w}{P_c}$$

$$P_c = \frac{P}{n} \qquad (2)$$

where nw is the loading per foot of wire producing the maximum tension P, and w is the loading in pounds per foot which produces the tension P_c when the temperature is such that the sag of the conductor hanging in still air is the same as the maximum deflection under storm conditions.

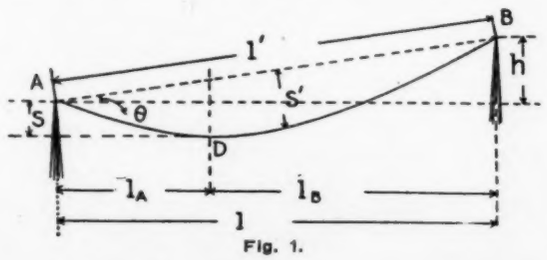


Fig. 1.

The sag at any other temperature will depend upon the length of the wire in the span, the connection between these quantities being given by the formula

$$\lambda = l + \frac{8s^2}{3l} \qquad (3)$$

which is the approximate expression for the length of a parabolic arc.

When the points of support A and B (see Fig. 1) are not on the same level, but are so nearly at the same elevation that the lowest point (D) of the span lies somewhere between the two points of support, the length of wire may be considered as the sum of two half spans of lengths l_a and l_b, respectively; this leads to the formula

$$\lambda = l + \tfrac{2}{3}\left[\frac{(s+h)^2}{l-l_a} + \frac{s^2}{l_a}\right] \qquad (4)$$

wherein the symbols correspond to the lettering of Fig. 1. By assuming different values of sag, s, the corresponding tension in the wire may be calculated by substituting $2l_a$ for l in formula (1), and the length of arc may be calculated by formula (4). Variations in the length of wire are due (a) to change of tension, (b) to change of temperature. The change in length due to cause (a) is known, because, for a given sag, the tension is known, and it follows that the change in temperature to produce such elongation or contraction as is not accounted for by change of tension can easily be calculated. This outline of the method of obtaining data for the plotting of sag-temperature

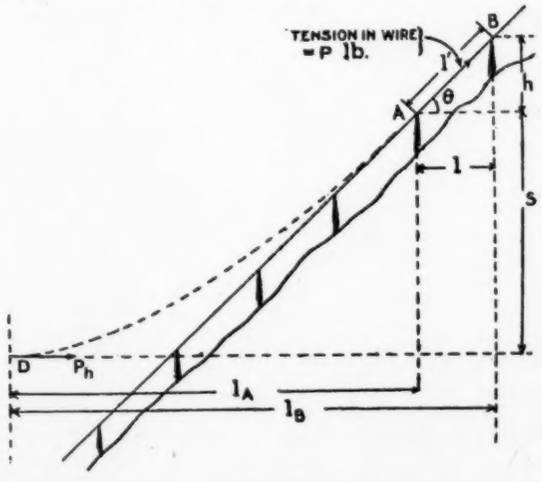


Fig. 2.

[1] This calculation, together with formulae for use in obtaining sag-temperature curves, are given in the writer's book, "Overhead Electric Power Transmission."

curves will suffice to show that small errors in calculating the length of the wire may lead to serious errors in the final results.

The horizontal distance l_a from the lower support A to the point D where the wire is horizontal (see Fig. 1) is readily calculated by considering that at the point D, where the horizontal component of the tension is P_h, the vertical component is zero; while at a point half way between A and B the vertical component of the tension is $P_h \tan \theta$, or $P_h \times h/l$. This must be equal to the weight of a piece of wire of which the length is $\left(\frac{l}{2} - l_a\right)\frac{l'}{l}$, approximately. Thus

$$P_h \frac{h}{l} = w \left(\frac{l}{2} - l_a\right)\frac{l'}{l}$$

whence

$$l_a = \frac{l}{2} - \frac{hP_h}{wl'} \qquad (5)$$

Consider now Fig. 2, where the span AB is supposed to be one a steep incline. If the formula (5) is used for calculating the distance l_a from the lower support A to the point where the wire becomes horizontal, this quantity will be negative. It will determine the shape and position of an imaginary parabolic curve as indicated by the dotted line of Fig. 2. The vertical component of the tension at the point B will be equal to the weight of the wire in the parabolic arc BD; while the vertical component at A will be the weight of the portion AD. The horizontal component (P_h) of the tension will be $P \cos \theta$, where P stands for the tension in the wire at the middle of the span AB.

Temperature-stress calculation can be made by considering the length of the wire in the span AB to be the difference between the imaginary half spans BD and AD, the procedure being exactly as indicated above. This method is, however, objectionable, because the required lengths are very small differences between comparatively large quantities, and unless several additional terms are added to the approximate formula for the length of the parabolic curve, serious errors may be introduced.

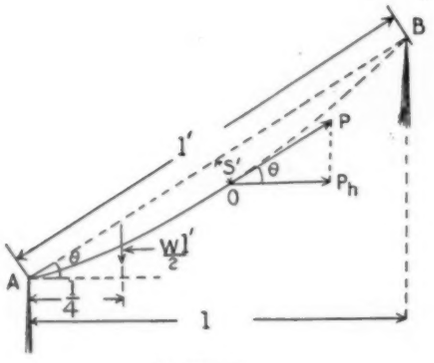


Fig. 3.

The alternative method about to be explained makes use of what may be thought of as an equivalent horizontal span.

Fig. 3 is an enlarged view of the span AB of Fig. 2. The deflection s' at the center of the span may be calculated by taking moments about the point A. The pull P in the direction AB, acting at a distance s', is balanced by the weight ($\frac{1}{2}wl'$) of the half span AO, acting vertically downward at an average distance $\frac{l}{4}$, whence

$$Ps' = \frac{wl'}{2} \times \frac{l}{4}$$

and

$$s' = \frac{wl^2}{8P \cos \theta} \qquad (6)$$

The maximum deflection s' of the wire from the straight line AB joining the points of support is always small relatively to the distance $l' = AB$; and in computing the length of a curve which approximates to a straight line, no appreciable difference will be observable, whether the curve be considered as part of a parabola, or catenary, or ellipse, or circle. For our purpose, it will be most convenient to calculate the length of the wire by using formula (3), merely substituting s' for s, and l' for l.

The method of procedure here recommended for the calculation of sag-temperature or tension-temperature data can therefore be summed up as follows: Consider the span of either Fig. 1 or Fig. 3 to be replaced by an equivalent horizontal span of length l', being the straight line distance between the points of support, and of sag s' calculated by formula (6). Consider also that the vertical loading of this imaginary span is now $w \cos \theta$ pounds per foot run, distributed uniformly over the length l', and then proceed with the calculations exactly as in the case of spans having the two supports on the same level.

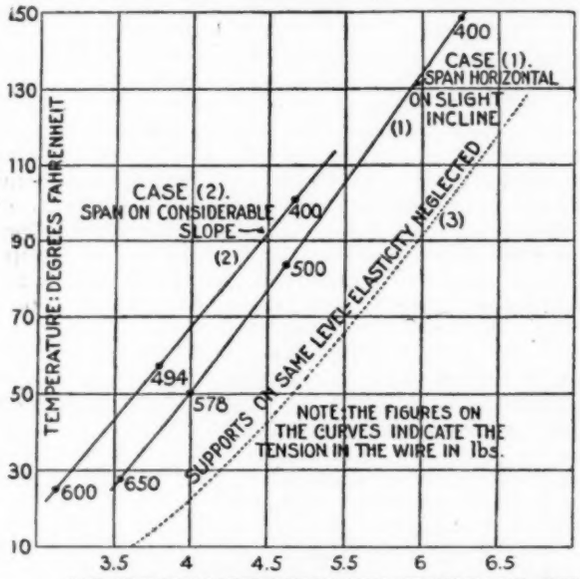


Fig. 4.

When the difference in levels is considerable, as in Fig. 3, the proper correction must be made in calculating the factor n. Thus, if w is the weight per foot of the wire (ice loading neglected) and p is the maximum (horizontal) wind pressure per foot of wire, the resultant load under storm conditions will be $\sqrt{w^2 + p^2}$ and the value of n, as previously defined, will be

$$n = \frac{\sqrt{w^2 + p^2}}{w} \qquad (7)$$

for horizontal spans. When the angle of slope θ becomes so large that $\cos \theta$ differs appreciably from unity, we must write

$$n = \frac{\sqrt{(w \cos \theta)^2 + p^2}}{w \cos \theta} \qquad (8)$$

which is the value to be used in formula (2) when calculating the "critical" tension P_c from the assumed or specified permissible maximum tension P.

Space does not permit of the complete working out of a numerical example, but the results of some calculations on a practical line have been plotted in Fig. 4.

The assumptions as to distance between supports, maximum load, etc., are such as would be normal—even if unreasonable—in England, where the regulations governing factors of safety and construction details are not such as to encourage the development of power transmission by overhead conductors. The reason for choosing data based on British rather than on American practice will be explained later.

DATA FOR CALCULATION OF RESULTS GIVEN IN FIG. 4.

Wire: No. 0 B. & S. solid copper. (This is almost exactly the same size as No. 0 S. W. G.)

Diameter of wire, $d = 0.325$ inch.

Cross-sectional area of wire, $A = 0.083$ square inch.

Weight of wire per foot, $w = 0.32$ pound.

Distance between supports measured horizontally, $l = 195$ feet.

Difference of elevation between points of support, $h = 140$ feet.

Whence, Distance between supports measured on slope, $l' = 240$ feet.

Breaking stress (say), 55,000 pounds per square inch.

Factor of safety = 5.

Maximum wind pressure = 15 pounds per square foot of projected area of wire.

Temperature at which maximum wind pressure occurs, $t = 22$ degrees F.

The curve marked (2) in Fig. 4 gives the relation between temperature and deflection (s') which can be measured by sighting from pole to pole on the incline. The figures on the curve are the tensions corresponding to particular temperatures. Tensions for intermediate points can very quickly be calculated by means of formula (6) if it is desired to erect the conductors with a dynamometer rather than by measuring the dip.

The curve marked (1) refers to the same span placed horizontally; that is to say, with the points of support 240 feet apart on the same level. In both cases the specified limiting tension in the wire will be reached at a temperature of 22 degrees Fahrenheit, with maximum wind-pressure in a direction perpendicular to the vertical plane passing through the points of support.

The dotted curve marked (3) in Fig. 4 is plotted from the same data as curve (1), except that the effect due to the elasticity of the wire has been neglected. The omission is often permissible, especially on long spans of aluminum wire, but on comparatively short spans of copper wire, as in the present instance, it is seen to give inaccurate results. The point has been referred to because of the peculiarity that in England—where the stringent regulations involving large factors of safety necessitate uneconomical construction with short spans—it is by no means uncommon to neglect the elasticity of the wire; while in America—where the longer spans are the cause of reduced stress variations—it is customary to take account of the changes in length due to variation of load.

LATEST COPPER STATISTICS SHOW SMALLER PRODUCTION FOR 1917.

The United States Geological Survey has issued an advance statement, showing the 1917 production of copper, compiled by B. S. Butler. It shows the smelter product to be 1,886,000,000 pounds, which was 2.18 per cent less than that of 1916. The value of the 1917 output, figured at the average price of 27.3 cents per pound, was $514,910,956, as against $474,288,000 as the value of the 1916 output.

PRODUCTION BY STATES.

The following table shows the copper production by states for the years given. The leadership of Arizona as a copper producer will be noted, and attention may be called to the fact that among the ten heavy producers the Territory of Alaska stands seventh, surpassing each of the states of California, Tennessee and Colorado.

	1914.	1915.	1916.	1917.
Alaska	24,985,847	70,695,286	113,823,064	84,759,086
Arizona	382,449,922	432,467,690	694,847,307	719,035,514
California	29,784,173	37,658,444	43,400,876	44,933,846
Colorado	7,316,066	7,272,178	9,536,193	10,054,951
Georgia	.....	.....	803,699	930,691
Idaho	5,875,205	6,217,728	7,248,794	6,446,224
Maine	.....	.....	.....	34,872
Maryland	12,248	15,426	126,965	291,501
Michigan	158,009,748	238,956,410	269,794,531	268,508,091
Missouri	53,519	306,406	377,575	407,141
Montana	236,805,845	268,263,040	352,139,768	276,225,977
Nevada	60,122,904	67,757,322	100,816,724	115,028,161
New Jersey	.....	.....	4,115	.....
New Mexico	64,204,703	62,817,234	79,863,439	107,593,615
North Carolina	19,712	33,383	5,961	125,004
Oregon	5,599	797,471	2,433,567	1,105,097
Pennsylvania	422,741	.....	904	115,000
South Carolina	.....	.....	.....	210,000
Tennessee	18,661,112	18,205,308	14,556,278	16,093,757
Texas	34,272	38,971	86,463	2,061,129
Utah	160,589,660	175,177,695	232,335,950	227,840,447
Vermont	.....	23,995	324,400	102,522
Virginia	17,753	50,008	1,066,143	146,912
Washington	683,602	903,661	2,473,481	2,051,416
Wyoming	17,082	351,871	1,784,351	2,019,767
Undistributed	65,479	.....	.....	.....
	1,150,137,192	1,388,009,527	1,927,850,548	1,886,120,721

COPPER IMPORTS.

The imports of copper to the United States for 1916 and 1917 are shown to have been as follows, the figures being copper content in pounds:

	1916.	1917.
Copper in ore	124,878,905	116,500,532
Copper concentrates	32,753,874	38,197,532
Matte and regulus	17,155,075	21,048,943
Unrefined copper	268,927,315	355,598,036
Refined copper	8,411,230	6,751,958
Clippings	9,451,388	17,893,594
In other forms	758,193	429,702

The largest exporters of copper to the United States during the two years were Cuba, Canada, Chile, Mexico and Peru.

MILWAUKEE LEAGUE ISSUES ELECTRICAL DIRECTORY.

The Milwaukee Jovian Chapter has compiled and published an Electrical Directory of Milwaukee, Wis. The booklet contains the names and addresses of local members of that organization, with each one's company connection; also, a complete directory of electrical manufacturers, dealers, contractors, engineering firms and others concerned in handling and making electrical goods. The directory contains no advertising matter, no financial assistance having been received from that source. It was published entirely at the expense of the Milwaukee Jovian Chapter. One feature is that of giving not only the office addresses, but the telephone numbers of companies listed.

George J. Kirchgasser is president of the Milwaukee League.

Banking of Distribution Transformers

Discussion of Fundamental Considerations Involving Economy and Quality of Service—Importance of Certain Precautions Pointed Out

By P. O. REYNEAU and H. COLE

Distribution Engineers, Detroit Edison Company.

IN ORDER to get down to the fundamentals underlying the advisability of banking single-phase distribution transformers or not banking them, it is best to consider the proposition from two standpoints —that of economy and that of quality of service it is desired to furnish. These two bases may or may not conflict with one another according to conditions, but it is by a wise consideration of both that the most satisfactory conditions can be obtained on any distribution system, that is, conditions that will be most satisfactory both to the public and to the operating company.

Economy.

First, in the matter of economy, it is necessary to make a complete study of the annual charges against any system to determine the most economical size and arrangement of the units of that system, no matter whether the transformers are banked or unbanked. This study should consider the following items: Annual charges on wire, annual charges on transformers and accessories such as lightning arresters, fuses, etc., core losses, transformer and secondary copper losses, and annual operating, maintenance, inspection and testing charges. A study of this nature would show a combination of wire and transformers which would be best for a given density of load considering the load to be uniformly distributed along the secondary mains. This is, of course, a theoretical condition but would quite often be approximated and could easily be adapted to fit special conditions. The matter of service, however, must also be considered in this connection as the size of wire and the spacing of transformers should be such as to keep the maximum voltage drop in the secondary system below a certain limit. Such a study would undoubtedly favor the unbanked system if considered only from the standpoint of a definite load condition as a certain amount of wire might be saved and secondary fuses would be unnecessary.

The actual problem, unfortunately, is not so simple as this, due to the fact that conditions can never be considered as static. Load is liable to increase or decrease and to shift from one place to another. In fact, conditions are changing continually so that it becomes necessary to devise not only a system which is most economical under the present conditions but one that will lend itself most economically to adjustment to the load fluctuation. Here it is quite possible that a banked system will prove to be most economical in the long run on account of flexibility which it offers to handling various load densities. If a secondary system is designed to be just satisfactory at a certain condition of load, any slight increase would cause either an overload on the transformers, or an excessive voltage drop, or both. For this reason, a system must be designed with an allowance for an increase in load and the amount of this allowance should depend upon the expected increase and upon the ease with which the system adapts itself to handling it. Let us compare the two systems in this respect.

Comparison of Unbanked with Banked System.

In an unbanked system, if the wire installed is heavy enough, and the load increases, the transformers may be replaced for a while with larger units in the same location, providing the center of load does not shift too greatly. A very considerable increase or shifting of load, however, will necessitate the cutting up of the secondary unit into smaller units. If tapering secondary mains have been used, this may mean a large amount of replacement of secondary wire or else result in some very peculiar and inefficient condition as to wire sizes. Even if uniform secondary mains are used the cost of cutting up the system will be considerable. It will also probably be necessary to provide a surplus transformer capacity when these new units are added unless it is made a practice to change transformers frequently using very slightly varying sizes, thereby increasing the stock to be maintained in the warehouse.

In a banked system, with wire heavy enough to give the same drop each way as the unbanked system, the transformers may be replaced as before with the added advantage that loads coming on between transformers will have a two-way feed which will cut down the voltage drop at that point. Also the replacement of any transformer in a bank with a larger size of transformer will not only relieve its overload but will tend to take a part of the load from the adjacent transformers due to the lower impedance of the larger unit and in this way the growth in load may be taken care of gradually and with a smaller excess transformer capacity. Experience has shown that it is entirely possible to bank transformers of unequal capacities in this way without difficulty if they are properly located, as the impedance of the secondary system between units will prevent the larger transformers from taking too large a share of the load. Of course, too wide a difference in transformer sizes is not to be advocated from the service standpoint, as one large transformer going out may in this case cause the whole bank to go out.

When the voltage drop becomes too great in a banked system new transformers may be added to the bank and the old transformers moved so as to bring them nearer to the load centers. For this reason it is most feasible to use one size of wire for all secondary mains except in very special cases. Also when the wire has once been installed and the services connected to this wire, it becomes an expensive proposition to change it to another size. Transformers, therefore, are much more moveable parts of a distribution system than the wire and the same results as to voltage regulation are obtained much more cheaply by changing the transformer locations than by changing the size of wire.

Quality of Service.

Our second basis for judging whether transformers should be banked or not is the quality of service it is desired to furnish. If the best possible service is required, banking will undoubtedly be preferable as it is

possible by this method to insure practically perfect service, as far as the secondary distribution system is concerned, as trouble on a well constructed secondary main is very rare. This possibility has been proven in actual practice. The banking must be done, however, with the idea of service in view or it will be of no very material advantage. If the secondaries of the transformers are merely tied together through fuses and the secondary side of the transformer is not fused, the condition is very little better than that in an unbanked system except possibly a slight lowering in the transformer capacity necessary due to a diversity factor between transformers. There is certainly no material advantage in banking from the service standpoint if the main object is not protection of service, if necessary, at the expense of the transformers.

If transformers are banked with the idea of giving continuous service, it is necessary to use fuses in such a way that only defective transformers will be disconnected from the network. For this reason the primary side should be heavily fused to prevent a fuse from blowing on any slight trouble on the secondary system. The secondary side of the transformer should also be fused so that the transformer will be disconnected from the line if defective, and the fuse should be large enough so that it will not blow before the primary fuse has blown. There are on the market fuses for the secondary side of transformers which can be secured at a comparatively low cost so that the added expense is not great and probably less than the cost of fusing the neutral points between transformers. These are made of copper and may be easily removed by the linemen while working on the transformer.

As was said before, practically any degree of perfection in service, so far as the secondary distribution system is concerned, may be obtained with banked transformers. A bank of transformers may be designed so that the cutting out of any one transformer will cause very little variation in the voltage at the worst point in the bank. If this variation is enough to cause a complaint from the customer, the defective transformer may be replaced and conditions brought back to normal immediately. If the condition is not serious enough to cause complaint, the trouble will be discovered and remedied when the regular inspection is made. It is undoubtedly less disturbing to the customer to have a slight voltage variation of this kind than to be entirely out of commission for several hours.

Capacity Required in Bank.

In order that load of the defective transformer may be picked up in this way by the adjacent transformers, it is naturally necessary that the transformer capacity of the whole bank be large enough to take care of the emergency. In a large bank, however, the amount of this surplus capacity would be comparatively small and the capacity of transformers needed in this case would not be nearly so great as would naturally be installed in an unbanked system for the same district.

In conclusion it should be brought out that, although excellent service is given in many instances with unbanked systems, it is possible with proper care to give a higher grade of service with a system of banked distribution transformers. Proper testing, inspection and design, coupled with an excellent overhead lines condition are necessary for such results. It is, therefore, by proper selection of the quality of service desired and the best possible economy obtainable with that quality of service that the truly efficient distribution system can be obtained.

HURLEY ASKS CO-OPERATION OF COAL OPERATORS.

Impressive Address Before National Coal Association Emphasizes Importance of Fuel in Winning the War.

Edward N. Hurley, chairman of the United States Shipping Board, in an address delivered at the meeting of the National Coal Association, Philadelphia, May 28, set forth war efficiency as the supreme test of both business management and labor. He was gratified, he said, to know that the Government now recognizes that the coal men of the country, in effective organization, should co-ordinate with representatives of the Government to work out industrial problems in a practical way.

The fact that, previous to the war, there had always been an over-production of coal led to the lack of appreciation of our coal resources; and the importance of the coal producer was brought home to the nation last winter. That experience broadened your vision and emphasized your responsibility in this country's affairs. It also gave the American people a better understanding of this industry and the magnitude of the task of coaling the United States. At the same time they expect you to do your part in carrying out the nation's war program, said Mr. Hurley.

The Government's taking control of the coal industry was absolutely necessary, and most all men now realize that the Government is going to take an important part in our affairs hereafter. We must adapt ourselves to new conditions that prevail, and we are supremely interested in getting the best results. The best way, then, is to co-operate with the Government in an intelligent and sympathetic manner, and your association, from its inception, has taken precisely that position. Every coal operator is enlisted in the service of the Government for the production and distribution of coal. The United States Fuel Administration has placed coal distribution in the hands of practical coal men, and in order to be successful we must have the co-operation and support of every coal man in the United States in whole-hearted, patriotic way. In part, he spoke further, as follows:

In past wars, victory was thought largely a matter of military strategy. Under our highly organized system of today the whole weight of the nation must back up with its full resources military and naval action. Otherwise there can be no effective action This means that everything of basic importance needed to carry on the war must be operated as a unit. Coal is a fundamental. Transportation for the carrying of coal and other commodities is another fundamental. Our Government is going ahead with the co-ordination of railroad systems, inland waterways, coastwise and ocean transportation. Railway equipment is being provided.

Whatever the length of the war, we are preparing in good measure for present and future. We are doing it in a large way, worthy of our great country. Not only for the war, but for the times after the war when we shall be called upon to do the immense work of rehabilitating devastated Europe. Other countries needed our coal before the war—nearly 21,000,000 tons of it annually. They have needed more of it since the war began. They will need it after the war. And we will not only have the vessels and other vehicles to carry on our inland and coast waters and on our railroads the millions of tons of coal used yearly in this country, but we shall have a great merchant marine of our own to carry coal and all other American products to other countries.

Editorial Comment

Profit Sharing by Electrical Contractors

ULTIMATE analysis of the countless controversies between capital and labor demonstrates that they are due to the absence of brotherly relations between these two essential elements to modern industrial business. Without discussing the various causes for this dearth of fraternal feelings, it is evident that it has led to failure by each party to see and appreciate the other's problems and from that have developed those unfortunate misunderstandings that so frequently culminate in strikes and lockouts. Failure to recognize each other as necessary copartners in industry makes each believe itself the superior in importance and even results in such extremely radical developments as plutocratism, socialism and anarchism. A striking example of this radical tendency is seen in the present control of Russia by the bolsheviki.

Especially acute is the labor unrest now prevailing due to the abnormal conditions brought on by the war, particularly the increase in living expenses. The national crisis is not ameliorated by having able workers idle away valuable time because of failure to agree on working conditions or other possible points in dispute. The situation, on the contrary, calls for the most intense application by every employer and employee so as to hasten successful termination of the war. All possible causes for dispute should be cleared up and, where these originate from failure to understand each other's viewpoints, frank and open-minded discussion of all problems bearing on the controversy is a patriotic duty, since fair consideration of all angles of the question usually leads to its solution.

Looking at the various leading branches of the electrical industry, we find that in each there have been controversies between employers and employees, but to a much less extent in electric central-station companies than in street-railway, manufacturing, telegraph, and contracting companies or firms. One of the reasons for this relative freedom from labor disputes of central stations is that many of the larger companies have formed organizations of their employees as company sections of the National Electric Light Association and at these section meetings there is a full and frank discussion of the numerous problems confronting these utilities. The outcome is a more thorough understanding and therefore more cordial relationship between the company's executives and their subordinates. Another reason is the practice of quite a few companies of applying profit sharing by making as many employees as possible stockholders in the company. This gives the men an immediate personal interest in the success of the business that not only keeps them from making unreasonable demands upon it but makes them active boosters for its growth.

A very striking contrast to this situation is disclosed in the electrical contracting business. As a rule, there is little common understanding between the boss contractor and his employees as to the difficulties the other has to contend with. This is one of the chief causes for the numerous labor troubles among contractors. It is also the cause of many wiremen quitting their jobs and starting up in contracting business themselves, since the idea that there is enormous profit in the business prevails among many of the men until they have found out differently by sad experience. A candid explanation of the actual situation and unbiased discussion in brotherly fashion would dispel much of this misinformation. Especially effective, however, is adoption of the plan of profit sharing, offering it to all tried employees after a number of years' connection with the business.

This plan is being followed by a few electrical contractors with much success. At first it should be offered the higher salaried employees, such as superintendents, engineers, estimators and foremen; extension to other employees may follow observance of the operation of the plan and revision of any necessary details before it is applied to a larger number. Of the particular benefits resulting from profit sharing it is necessary to point out only a few. One is that it gives the men an insight into the real conditions of the business so that they are willing to share in its ups and downs without grumbling when the latter are unavoidable due to general business depression. It also gives each man a personal incentive to work for the continued success and upbuilding of the business, bringing to it sources of income and eliminating from it avenues of waste that he would not think of otherwise. Furthermore, it makes the men contented to stay and develop with an established firm instead of shifting from one to another like a weathercock. To the electrical contractor this means retaining experienced employees and also avoidance of their independent entry as "curbstone" competitors in the business. This latter ruinous competition has long been the bane of the contracting craft. All told, this matter is worthy of thoughtful consideration by the contractors, especially at a time like the present when time is available to work out difficulties that may develop when conditions are restored to normal.

Other branches of the electrical industry may also find it advantageous to consider seriously adoption of the profit-sharing scheme. Wherever it has been given a fair trial, the results have been very satisfactory, making for peaceful and harmonious relations.

Turn Light on the Boiler Room

ATTENTION of the country is now turning again to boiler rooms of power and heating plants. Plants are at last to be subject to government inspection. Apparatus and layout may eventually be improved, operating methods will undoubtedly in many instances be radically changed, and education of varying degree will replace the proverbial vagueness and ignorance that so often characterize the personnel of many a boiler room. It is to be hoped that the question of boiler-room lighting—which, by the way, is not mentioned in the Government's questionnaire—will receive the consideration it deserves. Correct illumination is vitally related to performance of both apparatus and personnel, efficiency and safety of operation and life of apparatus, and comfort of the men.

Too many, perhaps most, boiler rooms are improperly and insufficiently lighted. There is insufficient illumination, lighting units are not installed where needed and often cause more discomfort than benefit, casting a glare in the firemen's faces instead of on the object to be seen, masking conditions instead of emphasizing them. There has of late been a wide tendency to curtail illumination on the score of economy. But few perhaps realize the extravagances, the wastes and the dangers chargeable to improperly illuminated boiler rooms, that capitalized exceed a thousand fold the paltry cost of the illumination.

Many things go on in the dark that would not be tolerated in the light of day. And the light of day never enters many a boiler room. Apparatus and methods cannot be efficient for any length of time where supervision is lax or lacking altogether. And the darker a boiler room, the greater the laxity and the lower the efficiency of inspection and workmanship, and results therefore. Removal of soot and scale by lance or by other manual methods is at best a trying process. But there is greater incentive to skimp the work and leave portions undone, consciously or unconsciously, where there is lack of light. So also inspection will fail to find the true state of affairs. Air infiltration through cracks in settings, warped doors, and so forth, go on unnoticed in dark portions of the plant. Uncovered steam pipes and boiler drums, direct leaks of live steam through defective flanges and valves, and of hot water pass unheeded in the shadows and dark that abound. Instruments, draft gauges, and so forth, expensive and of great possibilities for enabling economies, are misinterpreted and ignored and become deranged with dirt and lack of attention because there is insufficient light to allow them to be really useful. There is far more extravagance and loss of efficiency in boiler rooms on account of lack and improper lighting than is supposed. Conditions are bad enough in even well-lit plants. It is not difficult to surmise what they must be in those many others.

Not for boiler-room economies alone should lighting be improved, however. Improper and insufficient illumination is responsible for many of the accidents that occur due to stumbling over obstacles on the floor, falling into pits, hitting protruding objects, and so forth. The fact that flaws and conditions may exist unseen during hurried inspection is also conducive to accident and service interruptions. And the comfort of the men is not one to be belittled. Yet many a company that preaches illumination to its clients forgets to light its own power plants in a way that would make them safe and offer opportunity for them to be efficient.

There is no need for blazing illumination in a boiler room. But it is important that sufficient light be available when and where needed to make the place safe, enable maintenance of equipment in good working condition, and permit efficient operation. Without proper light draft gauges, recorders and other means of improving plant performance will be handicapped, efficient performance made doubtful and the investment in them largely discounted. A few protected fittings, plain and strong and enameled so as not to pick up and hoard dust and dirt, and permit of being easily cleaned, and installed to send their light upon the object to be seen and not upon everything else save that, is one of the first steps toward making a boiler room efficient. Turn on the lights.

Carry On

MORE wars have been won by siege than by assault. It is sustained effort that accomplishes results.

It is not the occasional sacrifice of some favorite edible that will save food for our soldiers and brothers in arms. It is the spirit of sacrifice day after day, sustained, that will accomplish the end sought.

It is not the hasty, well-meaning but ill-advised retrenchment of the individual, of private business or public utility that will bring real economy and reduced expenditure. It is the small saving here and there, where possible without untoward effect, wise and sustained, curtailment of needless things, that will bring worth-while economy eventually.

In the shipyards, coal mines, on the railroads and in the power plants and the homes it is sustained effort, sustained efficiency, sustained thrift, whether for production, economy or what not that will bring results. It is the old story of the tortoise and the hare over again, as true today as in the days of Aesop; the principle is really the same, only the circumstances have changed.

The Liberty Loans are the assaults, intensive, fierce, that carry all before them. The Thrift and War Stamps campaigns are the siege that must go on untiringly day after day, until their purpose has been attained.

More battles have been won by siege than by assault. The more intense the siege, the more like a sustained assault, the shorter it will be. It is sustained performance that counts. Carry on.

Week's Events

Jobbers Aid Contractors' Organization—Contractor-Dealers' Problems Discussed at Indiana Meeting—Other News

ELECTRIC POWER CLUB HOLDS ANNUAL MEETING.

War Service Sessions Feature Discussion at Hot Springs Convention.

The Electric Power Club, the national association of electric power equipment manufacturers, met in convention at Hot Springs, Va., on May 30 to June 1. There was an attendance of 75 delegates and guests, and thirty of the big electrical manufacturing companies were represented. Within the organization are 99 per cent of the manufacturers of electric power equipment in the United States.

Five new members, received into the association at this session, comprised the following:

Hamilton-Beach Company, Racine, Wis.; Marathon Electric Manufacturing Company, Wausau, Wis.; Electric Products Company, Cleveland; Kuhlman Electric Company, Bay City, Mich.; Stamford Electric & Manufacturing Company, Stamford, Conn.

Of the 12 members comprising the Board of Governors, four are elected each year. The new members chosen for those places on the board at this convention were as follows: J. C. Hobart, of the Triumph Electric Company, Cincinnati; W. A. Layman, of Wagner Electric Manufacturing Company, St. Louis; S. L. Nicholson, of Westinghouse Electric & Manufacturing Company, East Pittsburgh; F. M. Kimball, of General Electric Company, West Lynn, Mass.

The election of regular officers of the association resulted in the re-election of C. L. Collins of the Reliance Electric & Engineering Company, Cleveland, as president. James Burke, of the Burke Electric Company, Erie, Pa., was chosen vice-president; C. H. Roth, of Roth Brothers & Company, Chicago, was re-elected secretary; and R. J. Russell, of the Century Electric Company, St. Louis, was made treasurer.

Various papers of special interest were presented, each followed by discussion. The second day was devoted to war service sessions. Among the addresses pertaining to this was that of Walter Robbins, chief of the Power Equipment Section of the War Industries Board. He outlined the duties devolving upon his section and their relations to the Priorities division and to the Government purchasing department.

R. K. Sheppard, chairman of General War Service Committee of the electrical manufacturing industry, reviewed the work of his committee in an elaborate report to the Club.

The discussion covered a range of kindred subjects, including labor problems, transportation, freight embargoes, fuel supplies, conservation and engineering.

Dana Pierce, New York City, of the Underwriters' Laboratories, addressed the club on Safety Standards. This organization had been asked by the National Workmen's Compensation Bureau to draw up safety standards and place safety ratings on industrial control apparatus, and Mr. Pierce asked members of the Power Club to co-operate in this matter.

Dr. M. G. Lloyd, of the Bureau of Standards, addressed the Club on the National Electrical Safety Code prepared by that Bureau.

Chas. A. Pratt, of the Goodman Manufacturing Company, Chicago, presented sample specifications for storage-battery locomotives used in gaseous coal mines.

On motion of J. K. Bass, Chicago, action was taken to remit the Club dues to members who had joined the colors, for the period of their absence, and to add their names to the Club's roll of honor.

JOBBERS TO AID CONTRACTORS' ORGANIZATION.

Pledge Support to Enlist New Members and Will Join Association Themselves.

At the request of the National Association of Contractors and Dealers the Co-operation and Harmony Committee of the Electrical Supply Jobbers' Association met a committee of three contractors, appointed by the Contractors' association, at the Homestead Hotel, Hot Springs, Va., on Sunday afternoon, May 19, 1918.

The following persons were present, representing the Contractors' Association: W. K. Tuohey of Springfield, Mass., chairman; J. R. Strong of New York, N. Y.; G. M. Sanborn of Indianapolis, Ind. Representing the jobbers: W. E. Robertson, chairman, F. S. Price, N. G. Harvey, F. M. Bernardin, E. W. Rockafellow, Fred Bissell, V. C. B. Wetmore, F. Overbagh, F. E. Neagle and E. D. Tolles.

After a full discussion of the problems confronting the electrical contractors, a request was made by them, summarized as follows:

That the jobbers aid the contractors' association to increase its membership by personally, and through salesmen, urging contractors (not members) to join the association.

That in the same way the jobbers urge retail electrical dealers, hardware and other stores operating retail electrical departments to become associate members, and that jobbers operating retail departments also join the association, to the end that a far-reaching, properly financed campaign of education as to cost accounting and proper merchandising methods might be carried on, resulting in making the contractors better business men and merchants, and larger and better customers of the jobbers, with a corresponding improvement in the credit risk involved.

That the Jobbers' Association appoint a committee to attend the national meeting of the Contractors' Association at Cleveland in July and that this committee, preferably of three, meet a similar committee of contractors to confer from time to time with reference to matters of mutual interest.

They also stated they would be glad to accept con-

tributions from jobbers not operating retail stores to aid in financing this undertaking.

The jobbers' committee, in accordance with the objects expressed in the constitution of the association, recommended as follows:

(1) That all members of the Jobbers' Association having retail departments become associate members of the Contractors' Association.

(2) That the members of the association personally and through their salesmen urge all electrical contractors and electrical contractor-dealers to become members of the Contractors' Association, and urge all electrical dealers and other merchants operating retail electrical departments to become associate members.

As there seems to be some misunderstanding as to the meaning of the term "retail department" or "retail business," the following definition so as to avoid misunderstanding is given:

By retail departments, operated by jobbers, your committee understands the term to cover departments that sell at retail prices, in retail quantities, to the consumer, and expressly excludes sales to isolated plants, central stations and power companies, philanthropic, educational, health or corrective institutions or enterprises related thereto; industrial firms or corporations of every kind engaged in commerce or in undertakings relating thereto; the Government or any political subdivision thereof or agency in connection therewith.

(3) That the invitation to attend the national convention in July be accepted, and that the chairman of the Co-operation and Harmony Committee designate three members of the committee to attend.

CONSERVATION OF TECHNICAL ENGINEERS URGED.

Engineering Council Takes Steps to Utilize Technically Trained Men to Best Advantage.

Technical engineers of every branch of the profession who are taking part in the war activities of the Army and Navy are alarmed at the unfortunate waste of technical training caused by the drafting and enlisting of engineers for regular service with little or no regard for their technical attainments. These technically educated and experienced men are essential to the successful conduct of the war and cannot be replaced. There is continuing evidence that America is repeating in some measure England's mistake of sending technical men into the ranks when they should be carefully conserved for special duties in the fighting forces or on the technical staffs of the Army, the Navy and the essential war industries.

These facts have been forced upon the attention of engineers who have been co-operating with the Government through the Naval Consulting Board, the National Research Council and Engineering Council. Upon these organizations requests have constantly been made for engineers, chemists and other technical men for a great variety of military services. Thousands of names have thus been furnished to the Government departments and bureaus. Engineering Council especially has devoted attention to this personnel work through its committee, known as American Engineering Service, which has available classified lists of approximately 25,000 engineers and besides unclassified lists of many more. It is from these lists, directly or indirectly, that most of the names have been selected for war service.

Engineering Council was founded by the American Society of Civil Engineers, American Institute of Mining Engineers, American Society of Mechanical Engineers and American Institute of Electrical Engineers, and other engineering societies are co-operating with it in this service, the total membership represented by these organizations being approximately 50,000. Already from 10 to 15 per cent of the members of these several organizations are in the uniformed services of the country and it is safe to say that a large majority of their remaining members are in the Government civilian service or otherwise directly or indirectly engaged in the war. Engineers do not seek to avoid fighting, but earnestly desire to be given opportunities for fighting and other services in which they can be most effective and which cannot be performed by others.

It is known that through the Committee on Classification of Personnel in the War Service Exchange (of the War Department) and some other ways, efforts are being made to counteract the tendencies toward the loss of our technical men in the ranks of the Army and Navy. It is believed, however, that these efforts are insufficient and that they should at once be supplemented by other stringent measures dealing with the subject in the draft boards and recruiting stations.

In view of the foregoing, Engineering Council, created to provide means for united action and to speak authoritatively for its member societies on all public questions of common interest to engineers, respectfully offers the following:

Whereas, technically trained engineers are indispensable to the Army, the Navy and the war industries, in engineering corps, ordnance bureaus and signal corps, in aviation, submarine and tank service, in shipbuilding, and in many other assignments; and

Whereas, through draft and otherwise many of these irreplaceable men have been and are being diverted so that their special qualifications are not being utilized; be it

Resolved, that in the opinion of Engineering Council technically trained men of all ages should be enrolled and conserved for technical duties and special efforts should be made immediately by the War and Navy Departments to find and record such men among drafted and enlisted forces and to assign them to places in which their special qualifications are needed, and be it further

Resolved, that Engineering Council offers to assist the War and Navy Departments in locating and classifying such men, if its assistance be desired, provided these departments will give the necessary facilities for collecting information about engineers now in the Army and Navy or whose names are upon the selective draft lists.

These resolutions, offered solely in a patriotic spirit of helpfulness, were submitted to the Secretaries of the War and Navy.

THE EARLIEST ASSOCIATION OF ELECTRICAL CONTRACTORS.

J. E. Wilson, state secretary of the Electrical Contractors' Association of Massachusetts, sends out an interesting souvenir, consisting of an announcement of the first meeting of the New England Electrical Contractors' Association, held in Boston, June 5, 1899. It is believed this was the first association of electrical contractors to be formed in this country. It was later merged with the Electrical Contractors' Association of Greater Boston, which now forms the Boston district association under the jurisdiction of the Massachusetts State Association of Electrical Contractors and Dealers.

CONTRACTOR-DEALERS' PROBLEMS DISCUSSED AT INDIANA MEETING.

State Convention Held in Indianapolis—Co-operation with Jobbers Important Action—Many Notable Addresses.

The convention of the Indiana State Association of Electrical Contractors and Dealers, held at Indianapolis on May 28 and 29, took the necessary advance steps which will give the association what it most needs, and that is a membership that will make the organization fully representative of the branches of industry and trade for which it stands. Another distinctive step was to secure the co-operation of the electrical jobbers in building up the organization and helping to guide its destiny. The latter step was one in which several leading jobbers showed themselves to be in full accord. This was also in accordance with the advice of W. L. Goodwin, whose presence at the convention was an inspiration to the delegates to stick together, cast aside suspicions, and work untiringly. The fifty contractors, dealers and jobbers in attendance were in dead earnest and believed in the purposes of the organization. This fact resulted in a substantial increase of membership, and what the association now has is a good, working team as the basis of an effective state organization.

Another thing accomplished was to arrange for attending to the organization work through a regularly employed secretary. Geo. S. Skillman, Indianapolis, who thus far has performed these duties without remuneration, was voted a salary by the executive committee. The final steps taken in furtherance of effective co-operation, were the re-casting of the executive committee so it will be composed of three jobbers and three contractor-dealers. The committee now stands as follows:

The Co-operative Committee.

The Varney Electrical Supply Company, Western Electric Company, Indianapolis Electric Supply Company, representing the jobbers; A. L. Swanson, Evansville, A. B. Harris, Gary, and G. M. Sanborn, Indianapolis, representing the contractor-dealers.

An Active, Directing Force.

It is understood that the jobbers' salesmen will give effective aid in securing new members for the association, as supplementary to the efforts of the secretary in this direction. Mr. Goodwin suggested the appointment of some man, preferably a jobber, who shall act in the capacity of umpire in important matters and concerning which he may advise with Mr. Goodwin. G. E. Varney, president of Varney Electrical Supply Company, Indianapolis, was named for such position. The above working forces, together with the energy and ability displayed by A. L. Swanson, state chairman, give the association the means of getting the sinews of war.

Addresses and Discussion.

The addresses, speeches and discussion covered a considerable range, but most of the interest centered around the word "preferential." Price agreements and price maintenance, as between manufacturer and jobber, between jobber and contractor-dealer, and consumers' prices, were threshed out from various angles and viewpoints. The entire subject was clarified and reduced to something like a scientific basis by W. L. Goodwin when he told the delegates that the differential from the jobber in favor of the contractor-dealer would take care of itself when the latter got the facilities to take advantage of a preferential; that the necessary selling price of a commodity must be arrived at by a thorough method of figuring first cost and overhead expenses, plus a fair profit. This makes a fixed-price agreement unnecessary and inadvisable. In this connection Mr. Goodwin praised the stand taken by J. J. Gibson on the art of price making; and he pointed out that this does not mean price fixing.

First Day's Sessions.

The convention was opened May 28 by A. L. Swanson, state chairman. After some preliminaries, the convention entered into a series of discussions that terminated only with the close of the day. G. A. Engelken, secretary of Illinois state association, outlined the methods of procedure in developing the district organizations in that state.

Mr. Swanson told how the progress of the Indiana association had been handicapped by not having a paid secretary whose business it was to lead in securing members and attending to the affairs of the organization. He referred to the fact that 250 contractor-dealers had been invited to the convention and that less than fifty responded. However, it developed later that those who did come knew what the Goodwin Plan stands for, and were ready to do their part in putting it into effect.

An interesting discussion of Gibson's bulk sales idea was led by G. E. Varney, who spoke from the standpoint of the distributor. He showed how Gibson and Goodwin were working to similar ends, and took up the question of prices based on quantity and costs prorated to the number of transactions. In fixing a price to the consumer the dealer must sell service as well as sockets, wire and tape. Others entered freely into this discussion, including Fred Adam, St. Louis, chairman of the National Merchandising Committee; A. L. Swanson, Evansville; Mr. Oblinger of Indianapolis Electric Supply Company; S. S. Wilson, Cleveland; A. B. Harris, Gary; L. J. Granger of Tri-City Electric Service Company, Hammond; F. H. Cheyne, of Cheyne Electric Company, Indianapolis; Carl E. Nutting of Nutting Electric Company, Muncie; M. L. Spalding of Varney Electrical Supply Company; S. P. Wolever of Wolever Electric Company, La Fayette. All this discussion, centering around the subject of prices to contractors and dealers, brought out in clear relief the ideas of both jobbers and dealers, and no doubt opened the way for harmonious co-operation in the future. Both sides recognized the utility and fairness of the Goodwin Plan, and that eventually the sale of electrical appliances must pass through contractor-dealer channels. In discussing the need of a greater margin to dealers on appliances, it was shown that the dealer is often found cutting the margin which he already has.

Mr. Sanborn's Address.

The closing speech of the first day's session was by G. M. Sanborn of the Sanborn Electric Company, Indianapolis. He brushed aside all pessimistic views, and put in a convincing appeal for the support of the jobber in the work proposed by this organization, and spoke of the good results of a jobbers' committee conferring with a contractor-dealers' committee at Hot Springs, Va., and said committees of national jobbers and national contractors would meet again in Cleveland at the time of the national convention of the contractors and dealers.

Closing Sessions at Country Club.

The closing day's sessions were held at the Country Club, where the attendance reached the maximum of 75, including representatives of outside jobbers,

manufacturers and others concerned in the electrical industry.

Mr. Adam's Address.

Fred B. Adam of the Frank Adam Electric Company, St. Louis, gave a pointed and informing address on the "Possibilities of Merchandising." Mr. Adam is chairman of the merchandising committee of the national association, and brought to the subject many facts that originated in his field of wide experience and observation; and he is gifted with the knack of reducing things to clear-cut expression. The underlying purpose of the Goodwin Plan, as he expressed it, is to make good business men of electrical contractors, dealers and others. That the 25,000 electrical contractors and dealers in the United States should make good distributors of electrical appliances is a fact discovered by the General Electric Company, and to prepare them to assume this function is one of the purposes of the organization under the Goodwin Plan. But before this can be turned over to them the contractor-dealers must show themselves on the job ready to handle it. The jobber and dealer, each in his own line, are essential and we shall always have them with us. Both compel the manufacturer to deal with them. But the Wheatstone bridge should be kept in balance, to stabilize the industry. Both jobber and dealer may fairly ask a differential in his favor. In order to go to the manufacturers to ask a larger margin, that will reach down to the retail dealer, the request should be accompanied by a record of overhead costs in selling, for instance, such appliances as irons, vacuum cleaners and washing machines. A 25-per cent margin on a nationally advertised washing machine means a greater net profit than does the same margin on an unknown product, and each of the two should stand on its merits.

Mr. Adam emphasized the idea that the public should be made aware of the fact that the contractor-dealer furnishes the proper channel through which electrical appliances are sold, otherwise the drug store, department and general store will soon have control of the trade. If the contractor-dealer fails to uphold his prices, if he makes a cut on appliances to one man whose house he wired and to another because he is a club-man, the manufacturer and jobber will not listen to his plea for a greater margin because he did not protect the margin he had. On the other hand, there should be an equitable differential from the manufacturer to the jobber and by him to the dealer, whereby also the consumers' price may readily be known.

Mr. Shepard's Address.

Ira C. Shepard, of the new-business department of the Public Utilities Company, Evansville, said that company stayed in the appliance business because the industrial conditions there required it. While established prices are maintained, the changing prices under existing conditions made this difficult. The plan of his company, he said, was for co-operation with the contractor-dealer and work along the lines marked out under the Goodwin Plan. Mr. Shepard believes in uniform prices and better service, and one of the most pertinent truths he uttered was that dissatisfaction on the part of customers does not result from maintaining standard prices, but usually from bad or unreliable service.

Discussion.

The discussion that followed veered around to the time-payment method of selling appliances, and the various problems arising therefrom. One point made was that the system of house-to-house canvassing was undesirable, and often pernicious. Another was that the practical demonstration of an appliance in the home of the intending purchaser was the most valuable and most satisfactory aid in closing sales.

Trade Acceptances.

J. D. Meek, vice president of Indianapolis Electric Supply Company, read an able paper on "Trade Acceptances," this having been the only paper presented at the convention. What gave special interest to Mr. Meek's paper was the fact the jobbing house, with which he is connected, has been putting in practice the trade acceptance plan in its business during the last year, and is well pleased with its practical workings. He said the credit men, bankers and trade-acceptance councils of the various cities were behind the proposition, and he believed it was to come rapidly into adoption. Many questions were asked and some discussion followed, engaged in by Messrs. Varney, Harris and Adam.

Mr. Goodwin's Address.

W. L. Goodwin, the recognized national leader of the contractor-dealer organization movement, appeared on the floor of the convention in the afternoon of the closing day and was enthusiastically received. His address, including time for answering questions, lasted two hours, during which the closest attention was given. He appealed to members to cut out all suspicion of each other and put the co-operative spirit into practice. The war has taught the necessity for co-ordination. Those who fight for us on the firing line are making the supreme sacrifice, and duty requires some sacrifices from us.

The electrical industry, said Mr. Goodwin, thus far has grown without direction and, as the result, some readjustments are necessary to deal out justice to the public, to the contractors and dealers. The contractor-dealer organization is weak in proportion to the number in that branch of the industry, only 5 per cent of them being in this organization. The result is that they have not sold the electrical idea to the public. While the public is spending $7 per capita in the industry, this sum might be raised to $40 per capita. The Jovians, the Society for Electrical Development, and other organizations, all formed to bring electrical people together effectively, have failed of their purposes, and the speaker declared that this organization of electrical contractor-dealers, with its fundamental principles, code of ethics, and open meetings, was probably the last effort that would ever be made to reach the ultimate consumer through co-operative organization. He deplored the non-existence of a code of ethics in business. In the fight for democracy politically, that principle must be applied commercially.

Mr. Goodwin now stated that of the 225,000 concerns engaged in retailing electrical goods in the United States, only 25,000 were strictly electrical concerns. The electrical contractor-dealers may be built into a strong, effective organization. No one fears such an organization except the men who have something that does not belong to them. To serve the public is the contractors' job. The co-operative spirit exhibited at the recent California convention showed what was possible when central stations, manufacturers, jobbers, contractors and retail dealers get together on the basis of serving the public.

There must be, he said, a differential price in favor of each branch of the industry, but this differential must be based on the service that each branch should render. Back of all, cost records must be developed, upon which to base differential prices.

ARKANSAS PUBLIC UTILITY OPERATORS IN ANNUAL CONVENTION.

War Problems and Economic Measures Discussed in Patriotic Sessions.

The Arkansas Association of Public Utility Operators held its eleventh annual convention at Hot Springs May 21 to 23, with President Stephen E. Dillon, general manager of the Citizens' Electric Company, of Hot Springs, presiding at its sessions. The addresses reflected the patriotic sentiment that dominated the action of the convention. One of the principal themes was the relation of the public utilities to war efficiency. The attendance was representative, though not as large as might have been expected. Opening addresses, reports and other preliminaries took up the first afternoon session, and this was followed by a reception in the evening.

J. F. Christy, manager of the Jonesboro Water & Light Company, read an impressive paper on the "Present Day Fuel Situation." He was followed with an equally stirring address by Hamp Williams, state food administrator, who referred to the record Arkansas had made in the line of food conservation. This state had sent to the war front a larger supply of food than had any other state.

W. T. Thorp, secretary-treasurer of the association, stated that thirteen companies had joined the organization within the last year, but that there were 75 non-member concerns operating in the state at this time. He said an effort would be made during the next year to induce them to become members. J. H. Butterfield, manager of the Hot Springs Street Railway Company, briefly addressed the convention.

The subject of Uniflow Engines was treated in a paper by Frank M. Beeson, of the Merkel Machinery Company, Kansas City, Mo. His paper had a special bearing on the conservation of fuel supplies. The subject was discussed by H. C. Couch, state fuel administrator, Little Rock.

A feature of interest, after adjournment on the second day, was a tour to the Hot Springs power plant, where visiting operators inspected the equipment and discussed problems of economy in operating.

A. Patterson, of the Southwestern Gas & Electric Company, opened the rate question in a paper in which the great necessity for rate increases was disclosed. This question in Arkansas has to be taken up in a different way from that in most other states because Arkansas has no public utility commission. Hence, all the discussion had reference to dealing directly with the consumers and their local representatives. Through all the expressions of opinion on the subject there was manifest a spirit of fairness, a desire to render the consumers good service, but suggesting ways of meeting the added expenses of higher operating costs. Some of the companies in this state operate under franchises in which rate agreements exist, and the matter of getting an increase requires pretty thoroughly opening the question in a public way. The subject aroused much interesting discussion.

As means of increasing revenues, it was proposed that special contracts, made years ago at low rates, be abrogated; that checking meters, and rechecking maximum demands, be adopted, and that a fuel clause be added to contracts in force.

C. J. Griffith, of Little Rock, reviewed the financial difficulties of the Little Rock company and pointed out the reasons for asking an increase in rates.

In view of the probability of a public utility commission being created in Arkansas, the public utility companies were advised to co-operate in securing a law that would be workable and fitting to conditions. In fact, the sentiment of the convention seemed favorable to rather than against regulation under a public utility commission.

W. R. Herstein, of Memphis, read a paper on "Courtesy to Traveling Salesmen." The association's name henceforth is to be the Arkansas Public Utilities Association.

The officers for the following year, elected prior to adjournment, are as follows:

President, D. C. Green, Fort Smith.
First vice-president, B. C. McKinnon, Eldorado.
Second vice-president, E. T. Leverett, Conway.
Secretary-treasurer, W. J. Thorp, Little Rock.

The Class B members, comprising salesmen representing manufacturers and supply houses, of whom 31 were in attendance, held a separate meeting and elected the following officers:

President, G. M. Ellis, district manager General Electric Company supply department, St. Louis; first vice-president, W. P. Holcombe, Moloney Electric Company, St. Louis; second vice-president, E. C. Brown, Ohio Brass Company; secretary-treasurer, C. C. Lewis, Columbia Lamp Division, General Electric Company, St. Louis. Fort Smith was selected as the place at which the next convention is to be held.

MOVEMENT TO CONSOLIDATE COMMISSIONS IN MASSACHUSETTS.

Public Service Commission and Board of Gas and Electric Light Commissioners to Be Unified as War Measure.

As this year's contribution to the principle of consolidation in government, the Massachusetts Legislative Committee on Administration and Commissions has now reported a bill which would unite two well-known state boards in a single body. It is proposed to combine the Public Service Commission and the Board of Gas and Electric Light Commissioners under a new title, "The Commission on Public Utilities." As the bill has been framed, it carefully avoids any revision of the powers which the two boards have always exercised. It merely endeavors to lift the functions of the old commissions bodily out of their hands and transplant them without change into the keeping of the new board. In so doing, however, it still keeps the labor distributed. Of the proposed seven members of the "Commission on Public Utilities," three would be designated to carry on the work formerly assigned to the Public Service Commission and three to take charge of the duties of the Gas and Electric Light Commissioners. The chairman of the main commission would hold this right of appointment and would also determine on which of the two divisions he himself would serve. The seventh member would be the secretary of the combined board, charged with executive responsibility for its office work, and empowered to vote in all matters passed upon by the main committee.

NEW JERSEY UTILITY BOARD REORGANIZED.

Reorganization of the New Jersey Board of Public Utility Commissioners has been effected by the re-election of Ralph W. E. Donges, of Camden, as president. Albert N. Barber, Trenton, and L. Edward Herrman, of Jersey City, continue as secretary and counsel of the Board, respectively, having been elected last year for a period of two years.

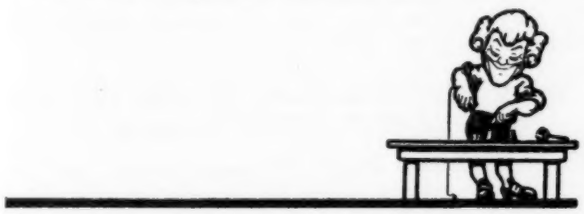
Commercial

Industrial Heating Appliances a Central-Station Opportunity—Electric Pumping Plant for Drainage District

INDUSTRIAL HEATING APPLIANCES OFFER CENTRAL-STATION OPPORTUNITY.

Although new business cannot be taken on by many central stations, largely because of the high prices for new equipment and the inability to secure new capital, there is hardly a utility that isn't desirous of improving the load-factor of present customers.

It is not uncommon to find an industrial plant with a highly efficient and modern motor installation and an antiquated lighting system. And in only very few cases have industrial heating appliances such as



As a progressive manufacturer you are adopting new devices as fast as you are sure of them. The *electric soldering iron* should come in this class. Its constant heat-retaining factor, its wonderful convenience as compared with other types, and the cleanliness and the economy of its operation have brought about its use for all soldering purposes

If you are not acquainted with these features, return the card and a representative will call upon you. You cannot afford to miss the facts he will bring you

The New York Edison Company
Irving Place and Fifteenth Street

[Detach here]

Post Card Sent by New York Edison Company to Industrial Customers.

soldering irons, glue cookers, japaning ovens, etc., been employed.

The inherent advantages of these appliances makes a stronger appeal under present conditions than ever before and considerable profitable business can be secured by following up existing customers.

The accompanying illustration shows a post card sent to industrial customers by the New York Edison Company, calling attention to the electric soldering iron. This is one of a series of post cards dealing with various similar appliances and has brought excellent results.

HEAVY SALES OF ELECTRICAL APPLIANCES IN THE SOUTH.

The New Orleans Railway & Light Company, New Orleans, La., which handles the Hoover electric suction sweeper in its territory, announce that during the month of April its vacuum-cleaner sales showed an increase over the same month of last year of several hundred per cent; sewing-machine motors 50 per cent, vibrators 40 per cent, and miscellaneous appliances 182 per cent.

ELECTRIC PUMPING PLANT FOR DRAINAGE DISTRICT.

Silent-Chain Drive a Feature of Motor-Driven Pumps—Central-Station Energy Used.

Pumping water by electricity, in large volume, against a low head, is exemplified by the Indian Grave Drainage District, in the vicinity of Quincy, Ill. A new motor-driven pumping plant recently was completed and put in operation for the reclamation of overflow land in that district.

The main transmission line, extending from the big Keokuk power station to St. Louis, takes a route through a portion of the district, and current is tapped off the main line to this special service line by switching devices. The contract to supply the district with power was made with the Quincy (Ill.) Gas, Electric & Heating Company. Energy is transmitted to the district's outdoor transformers at 23,000 volts; this is stepped down to 2200 volts for the pump motors, and to 110-220 volts for lighting and for operating pump primers and other minor uses.

The motors, which were furnished by Allis-Chalmers Manufacturing Company, consist of one of 200 horsepower and another of 400 horsepower, each an alternating-current, 25-cycle, three-phase machine, for operating at 500 revolutions per minute. This company, also, supplied three 200-kilovolt-ampere transformers for the pump motors, and three 7½-kilovolt-ampere transformers for lighting and pump-priming service, and a 100-kilowatt synchronous condenser, to operate in parallel with the motors for the betterment of power factor.

The pumps, to which the motors are connected by Morse silent-chain transmission, are installed in a concrete building, and consist of three Platt Iron Works horizontal, double-suction, split-case centrifugals, each of a capacity ranging from 20,000 to 42,000 gallons per minute, depending upon the head of 22, 15 or 7 feet against which they may be operated, the operating speed being 355 revolutions per minute. The three pumps are on shafts, so coupled as to make interchangeable connections with the motors.

The 200-horsepower motor, with a speed of 480 revolutions, is connected to the pump shaft with speed of 355 revolutions by a chain belt. The 72-tooth driving sprocket, keyed to the motor shaft, has a pitch diameter of 12.88 inches; the 37-tooth driven sprocket, on the pump shaft, has a pitch diameter of 17.65 inches. The two sprockets carry a Morse 1½-inch-pitch silent chain, 15 inches in width. The 400-horsepower motor transmits power to the pump shaft by means of two driving units running in parallel. That is, there are two sets of sprockets and chains, each of the same dimensions as in the 200-horsepower drive. This type of silent-chain transmission has wide application in electrically operated plants, ranging from those of 100 horsepower and less to as high as 1000 horsepower.

The Indian Grave Drainage District was established in the early 80's and comprises, approximately, 19,000 acres. In the past, the run-off within the district, which is estimated under maximum rainfall to be approximately 120,000 gallons per minute, has to be handled through gravity sluices with the usual unsuccessful results. Under the original plan of unwatering this district, there were approximately 7000 acres considered swamp land, and the additional several thousand acres are periodically inundated. Under the present plan of main ditches, laterals and operation of the pumping station, it is believed the entire 19,000 acres will be constantly available for useful farm production.

The drainage system and pumping plant were designed and carried through under the engineering direction of W. P. Bushnell, of Quincy; the work was performed under contract by B. Layton, Muscatine, Iowa.

ELECTRIC TRUCK OPERATING COSTS.

Data Covering Thirty-Day Period Shows Economy of Electric Vehicles.

In selecting transportation equipment sentiment, likes and dislikes, fancied or otherwise, should play a very small, if any, part. Transportation engineering—for transportation is an engineering problem, and should be approached like any other science—should be applied, particularly if most economical and efficient results are to be realized.

In the final analysis, the real test of a truck's value is its service record for a period of time sufficiently long to meet both good and bad conditions. A single-one-day demonstration under ideal conditions is not broad enough. It should take at least a month of steady work to prove the good qualities of a truck and bring out all its weak points, if any.

Following is a record of a 750-pound electric truck used in ordinary city deliveries for 30 working days. Compare with horse-drawn and gasoline truck costs to fully appreciate its true value:

Days operated	30	
Miles traveled	1140.5	
Kilowatt-hours used	319.5	
Number of miles per kilowatt-hour	3.57	
Greatest energy consumption for one day	13.	kw-h.
Smallest energy consumption for one day	10.	kw-h.
Average energy consumption for one day	10.65	kw-h.
Shortest run	33.5	miles
Longest run	46.5	miles
Average run	38.01	miles
Greatest merchandise load (overload of 750 lbs.)	1500	lbs.
Smallest merchandise load	500	lbs.
Average merchandise load (overload of 250 lbs.)	1000	lbs.
Energy cost per car-mile @ 3c per kw-h.	$0.008	
Energy cost per car-mile @ 4c per kw-h.	.011	
Energy cost per car-mile @ 5c per kw-h.	.014	
Maintenance (maximum estimate) including repairs and renewal of all mechanical and electrical parts, including tires, battery, and painting of wagon, should not exceed, per car mile	.04	

INDIANA COMPANIES PETITION FOR INCREASED SURCHARGE.

The Merchants Heat & Light Company and the Indianapolis Light & Heat Company, both of Indianapolis, Ind., have filed a petition with the Indiana Public Service Commission asking for permission to increase the present surcharge of five mills per kilowatt-hour which the companies are now charging and which will expire June 30, 1918. The companies ask the Commission, in view of the greatly increased costs of operation, to investigate conditions carefully and determine the proper surcharge to be charged for the year beginning July 1, 1918.

AN ELECTRIC IRON SALES DRIVE OF PUBLIC SERVICE COMPANY.

An electric iron campaign is outlined in the June Sales Bulletin of the Public Service Company of Northern Illinois. An appeal is made to the company's employes to get behind this summer campaign which is to extend to September 1. They are asked to sell the standard General Electric, 6-pound iron, with cord and plug, at $3.75, the payments required being 75 cents cash and $1 per month for the three succeeding months. This offer, which represents a reduction of $1.25 from the regular price of $5, is also being advertised in local newspapers and by circular letters to be sent out with light bills. The sales department, in its tips and hints to employes, suggests the liberal use of the telephone of evenings in offering this electric iron bargain to friends and acquaintances.

By having made purchases of these irons before the price advanced, the company is able to quote the price referred to. The salesmen and saleswomen are urged to keep in mind that in selling the electric iron they should also sell the electrical idea which is the foundation for electrical merchandising.

Employes receive 5 per cent commission on sales made outside of regular hours.

WEST VIRGINIA COAL MINES USE CENTRAL-STATION POWER.

The Hartland Power Company, recently organized as an independent public utility operation by W. S. Barstow & Company, New York, and Steel, Jones & Company, bankers of Philadelphia, is supplying the bulk of its power to coal mines at Hartland, Dorfee, Clay and neighboring territory. While its present capacity is sufficient to take care of existing contracts, provisions have been made for extending the power house and distribution lines to meet all increased demands.

The plant of the company is located at Hartland, on the Elk River, West Virginia, the center of the new coal mining activities, and consists of 1000-kilowatt General Electric steam turbines, complete with condensers, boilers, etc. All machinery is of modern, high efficiency type. Construction work is now completed, and within the next ten days the company will start operation. Transmission lines have been built up Middle Creek to the coal mines in this section, and are now being extended to other nearby developments. The coal operators are rapidly installing modern electrical machinery and a number of them are now ready for power. Within a radius of four miles of the power plant are located some 10 or 12 large developments.

ENGINEERING FOUNDATION BOARD MEMBERS ELECTED.

The trustees of the United Engineering Society, at a meeting held in Engineering Societies Building, New York City, on May 23, elected the following members of the Engineering Foundation Board:

Calvert Townley, of Westinghouse Electric & Manufacturing Company, 165 Broadway, New York; Silas H. Woodard, consulting engineer; Dr. Joseph W. Richards, professor of metallurgy, Lehigh University, South Bethlehem, Pa.; Dr. David S. Jacobus, advisory engineer, Babcock & Wilcox Company, New York; H. Hobart Porter, of Sanderson & Porter, consulting engineers, New York.

Operating

Lightning Arrester Grounds—Hazards of Corrugated Iron —Hydraulic Connections—Grading Coal for Chain Grates

INFLUENCE OF GROUND CONNECTIONS ON LIGHTNING-ARRESTER PERFORMANCE.

Seasonal Changes and Deterioration of Earth Connections Now Deserve Consideration.

By E. M. Cohen.

The operation of a lightning arrester depends upon the functioning of the ground or earth connection. The best, in fact the ideal lightning arrester may fail if the connection between it and the ground is not working because the ground wire is broken or because the resistance between arrester and earth has become excessively high.

In one instance to the writer's knowledge a number of arresters failed to protect the transformers in close proximity to them, and it was found that the earth wires had become corroded and finally broken off. The investment in lightning arresters was in this case utterly wasted because of lax inspection. Connecting up the earth with partially new ground wire overcame the trouble, an operation that would have prevented probably a financial loss out of all proportion to the cost of doing it.

In many instances, and this is more marked during the summer months, earth resistances increase. Thus a lightning arrester ground may be of low resistance during the winter and wet weather, but become one of high resistance during the hot weather when the soil is dried out by the combined influence of sun and absence of rain. In other instances the flow of dynamic current such as occurs when an arrester breaks down and allows current to flow from the line through the earth connection is responsible for drying out of the earth around the earth connection, immediately increasing the resistance of the latter.

Much discussion has centered round the question of whether or not lightning arresters should be fused. On the other hand an earth connection that may vary with the seasons may introduce as great a degree of uncertainty as the arrester that may or may not be in circuit because its fuse may or may not be blown. Moreover, whereas the fuse is recognized as a variable, and one requiring vigilance, the earth resistance is in the majority of cases looked upon as something that remains constant, and thus usually is allowed to go uninspected. Many an investment in lightning arresters is not bringing in the return that it might reasonably be expected to because improperly earthed. And then, the continuity of service, for which part of the arrester cost may be charged is not as high as it would be were there efficient protection against lightning.

The lightning season during which lightning is most severe is now here. Additional arresters probably cannot be readily obtained, and their price is high. It costs little and is worth considerable to survey those already installed, to determine their condition and the condition of their ground connections, electrically and physically.

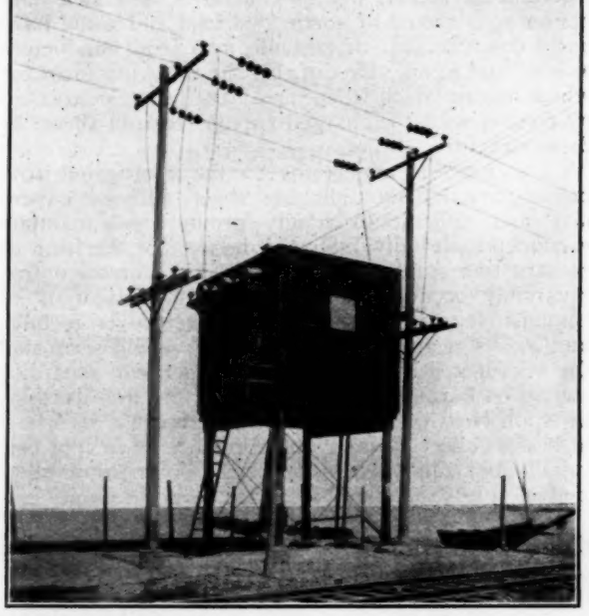
HOUSING WHAT NEED NOT BE HOUSED.

Life and Fire Hazards, Unreliability and Short Life Make Corrugated-Iron Structures Objectionable.

By Roger L. Evans.

War-time economies, experience and financial considerations are proving conclusively that it is unwise to spend money when unnecessary. One instance where needless expenditure is sometimes made is that where electrical apparatus is installed outdoors in a housing whereas a housing is not really necessary. All housings cannot be dispensed with, of course. But many exist that find no excuse. The money spent on them and the labor and materials necessary are wasted therefore.

The accompanying illustrations shows an outdoor installation, outdoor but enclosed, of lightning arresters on a high-voltage line. The electrical equipment is placed within a wooden structure which is in turn covered with galvanized or corrugated iron sheets. The sheets are fixed to the wood beams with nails. This class of installation is in wide favor and can be seen in use from coast to coast for all classes of transformation, switching and protection. Many of the installations are old-timers that have stood up. Others are built because they are standard practice with companies building them.



Typical Corrugated-Iron Structure for Enclosing Electrical Apparatus.

This class of structure may be criticized for several reasons. To begin with, in many instances there is no need to enclose apparatus, if outdoor equipment

is chosen. And then on the basis of initial cost it will often be found that there is little to choose between the outdoor installation and the one with indoor apparatus enclosed in a corrugated-iron structure. On the basis of upkeep the outdoor installation has all in its favor, because corrugated iron corrodes quite rapidly unless properly painted and the wood is protected from rot, whereas a steel frame, properly galvanized, has long life, high salvage, may be moved from place to place without deterioration, and plays an important part should the matter of evaluation ever come up.

But the chief objection to the corrugated-iron structure, of which only a type is here shown, is based on the grounds of life and fire hazards. Corrugated iron nailed to a wooden supporting frame will usually result in fire should the corrugated iron become grounded. Arcs readily set the wood on fire, as does also the flow of current from sheet to sheet. The corrugate-iron sheets may easily become charged, from any one of several causes, with voltage of from a few hundred to several thousand volts with operating voltages of the lines of up to 40,000 volts. Such a charged frame constitutes a serious hazard to workmen working in it or entering it where above ground. Pedestrians as well as workmen will also be endangered when these housings are erected on the ground.

The matter of life hazard is entirely one of grounding. But the matter of grounding is not an easy one. It is not easy to efficiently ground each individual corrugated sheet. And it is even more difficult to maintain such mechanical and electrical contact between sheets. The fire hazard is largely one of grounding also, although not entirely so, because the wooden framework must always constitute a combustible material which may be attacked by arcs.

The writer has known some half-dozen instances where transformer, lightning arrester and switching houses constructed of corrugated iron and wood have burnt down because of grounds, arcs from conductors to iron, and so on. He can also cite three instances for which he can vouch where men have been electrocuted by contact with the charged corrugated-iron sheets of these structures.

The inherent objections to the corrugated iron housing are that the individual sheets makes it expensive and difficult to rigidly ground and maintain grounded each individual sheet because of the form of construction employed and because of corrosion that invariably occurs; that the supporting frame is of combustible material; that the structure is metallic and covers relatively large space. It would seem that the corrugated-iron housing for electrical apparatus should be boycotted, on the basis of fire and life hazards, on basis of life and cost, and because its life is at best as uncertain as its performance, even if it permits indoor equipment to be placed outdoors on short notice, unless the above facts are borne in mind.

HYDRAULIC PENSTOCK AND PIPE, GATE AND VALVE CONNECTIONS.

Construction Details on Connections for Wood and Metal Flumes, Penstocks, Etc.

It is true that there are often several different ways of doing a thing right. It may also be true that there is only one best way of doing a thing. On the other hand, there may be several ways of doing a thing, all of them good, and each the best under certain circumstances. In the accompanying illustrations are shown various ways of making connections for penstocks and pipes (Fig. 1) and gates and valves (Fig. 2).

In Fig. 1 is shown, firstly, a method of connecting a steel plate pipe inside a wooden pipe; secondly, a wooden pipe or wood stave pipe bolted to the inside of a steel pipe; thirdly, a flange connection of two steel pipes, probably the commonest connection in hydroelectric work; fourthly, wood stave pipe flanged to steel plate pipe; fifthly, a flange connection joining two stave pipes together; and sixthly, an arrangement

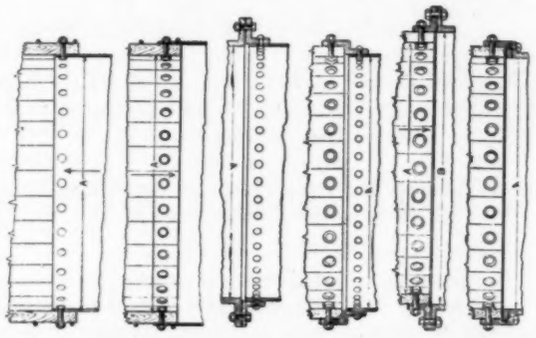


Fig. 1.—Various Methods of Connecting Wood and Steel Penstocks and Pipes.

of flanges for stave pipe, a coupling designed for minimum friction losses.

In Fig. 2 is shown, respectively, from left to right, an intermediate ring, two of which would be used for making a flanged coupling; method of employing intermediate ring or its equivalent as gate or valve; method of bolting ring to wood penstock; method of connecting up concrete with wood mat and split anchor bolts; method of connecting concrete with embedded spigot and flange; and lastly, method of connecting together pipe and concrete by plain imbedded spigot.

Local conditions largely decide the best form of construction to employ and choice of connections, and the accompanying illustrations show a number of methods that have proved satisfactory in irrigation as well as hydroelectric development. Today, with the scarcity of fuel, the increased demand for energy and the greater attention being turned toward water power, the development of water-power is tending to become increased. Additional plants will come into being, and

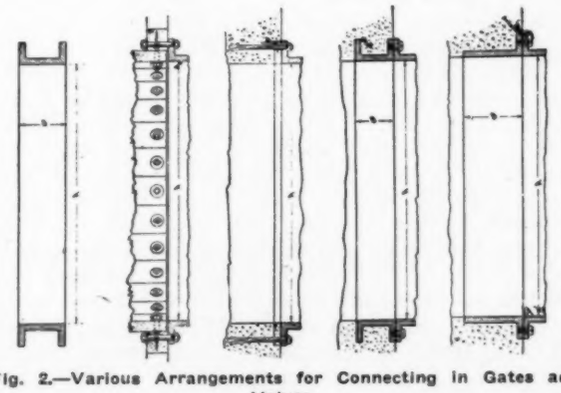


Fig. 2.—Various Arrangements for Connecting in Gates and Valves.

those already in existence are being more fully utilized.

The condition of the railroads and inability to obtain deliveries is also causing wood stave pipe to be used in place of steel in a great many instances where there would have to be protracted delay were it necessary to await deliveries of metallic pipe. Wood stave pipe is, of course, very much cheaper, initially, than steel. While its use is not usually advisable for long

life, more than ten years, it offers a ready means of transmitting water with material from close at hand.

VALUE OF LIGHTNING RODS.

The annual property loss in the United States due to lightning is approximately $8,000,000, chiefly in the rural districts, while the average number of persons struck by lightning is 1,500. According to figures compiled by the fire marshal of Ohio, the average number of buildings fired by lightning in the past five years, in that state, was 252, with loss of $381,060.

In Louisiana 104 fires, due to lightning, involving property loss of $26,634, were reported to the fire marshal during the past year. In only one case was the building rodded, and installation was defective.

The fire marshal of Indiana says: "Accumulating evidence shows that the lightning rod, properly placed, is certain protection against fire. Only three of the 273 lightning losses, during the past year, occurred on protected properties, and in one of those cases the lightning rod system was old and out of repair, and in another the lightning traveled to the building over telephone wires."

TURBOGENERATOR SHORTCOMINGS.

Although the turbogenerator is really an extraordinarily reliable piece of apparatus, it has of recent months received considerable criticism for giving trouble. One or two serious accidents have occurred, and in many cases shutdowns have happened at a time when they caused most inconvenience.

That large turbogenerators are able to run continuously under load for several months at a time ought to be testimony to the reliability of this type of machine and its auxiliaries, also to the high standards of service rendered by the leading central-station companies. On the other hand, probably every company operating this type of machine has had experiences where a machine has failed unexpectedly, the cause varying from a set of stripped blades or a burnt out armature or grounded field to merely an accidental tripping out of the steam or electrical end.

Operating experience of both large and small companies seems to be, conclusively, that turbogenerator design can well afford to be improved in the way of reliability. It is usually the little things that cause the trouble. So far as service interruptions are concerned the steam end perhaps is responsible for the most and least important delays, whereas the electrical end with its fewer delays causes the more protracted ones when they do occur.

A MECHANICAL COAL GRADER FOR CHAIN-GRATE STOKERS.

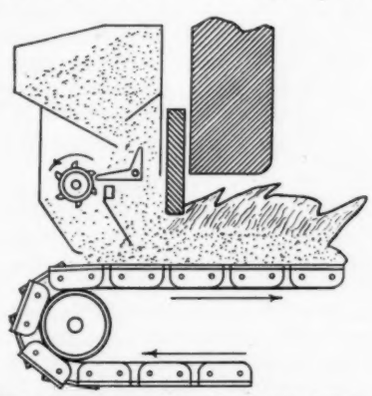
Ingenious Device for Grading Sizes of Coal Fed from Hopper to Stoker Grate.

It is generally understood that uniform coal size has a powerful influence upon combustion efficiency, as well as ease of handling and controlling the fire. The use of coal having radically different sizes of particles further complicates matters so far as adapting the grate to fuel used, interferes with the draft, increases the difficulty of maintaining proper thickness of fuel bed, and usually results in a higher loss of carbon in the ash pit. When coal has particles of radically different sizes, it can be seen at once that the smaller lumps tend to be consumed first, the larger ones later. If the rate at which fuel is fed to the fire is regulated for the larger particles a loss of capacity or rate of combustion follows. If the rate is regulated for the smaller particles, then the larger lumps tend to be sent to the ash pit without the carbon being fully consumed. There are other disadvantages, of course, such as the tendency for thin spots and thick spots to form in the fuel bed, and so on.

A rather interesting attachment has recently been gotten out, the object of which is to grade out coal particles just before the coal is fed to the stoker so that the larger particles pass to the grate at a point or points ahead of the points where the smaller particles are fed.

From the stoker hopper the coal passes through the screen consisting of a series of slotted plates pivotally supported and moving up and down intermittently because of the rotation of a toothed roller driven from the main stoker shaft.

The larger particles of fuel, the lumps or nuts which are not shaken through the screen, are removed by the toothed roller and deposited on the moving grate at a point, as shown, ahead of that at which the smaller and dusty particles of fuel which pass through the screen are deposited on the grate. In this way the moving grate as it travels towards the furnaces receives first a layer of the larger pieces of fuel from the toothed roller and thereafter a further layer of smaller particles of fuel and dust as the grate passes under the riddle towards the furnace. In some cases when it is desired to deposit the smaller particles of fuel passing through the riddle at a point on the traveling grate nearer the furnace, a baffle or guide plate, located below the riddle or screen, may be employed.



Mechanical Grading Device for Chain-Grate Stokers.

This baffle or guide plate may be provided with vertical corrugations for causing the layer of dusty fuel to be delivered to the grate in furrows. The necessary intermittent rotation may be imparted to the toothed roller by any suitable means, such as a ratchet wheel mounted on the shaft of the roller and pawl, the latter being actuated by the same mechanism as is used for causing the forward travel of the grate. The pawl should preferably be provided with suitable means whereby the speed of the roller may be varied in a well-known way so as to enable the delivery of the requisite quantity of graded fuel to be regulated as may be required. By dividing the roller transversely into sections and spacing such sections a greater distance apart than the width of the slots between the bars of the riddle or screen, an intermediate grade of fuel may also be separated out. With this arrangement fuel which is too large to pass through the riddle or screen will pass between the sections of the roller, still larger particles of fuel being removed and carried over by the toothed roller and deposited on the moving grate as described above.

Contracting-Construction

Lighting and Other Features of New Los Angeles Produce Market—Big Motor Repair Business—Among Contractors

UNIQUE ELECTRICAL FEATURES OF LOS ANGELES TERMINAL MARKET.

Wiring of Market Lighting Posts and Equipment of Adjacent Buildings.

By C. W. Geiger.

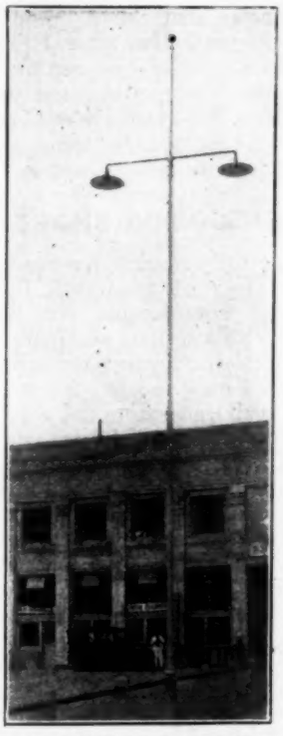
A new wholesale produce market has just been completed in Los Angeles, Cal., which is said to be the most complete and modern structure of its kind in the United States. For the purpose of bringing the farmers and produce dealers together, a paved market court 1400 feet long and 228 feet wide, has been surrounded by three concrete structures, one of which is 1541 feet long. This yard is divided off into 600 stalls for the farmers. The surrounding buildings have been designed especially for the purpose of housing the wholesale dealers in fruit and produce.

Lighting of Market Court.

The farmers begin arriving at the market at three to four o'clock in the morning, and many thousands of dollars worth of produce is disposed of before daylight. In order to facilitate the carrying on of this business in the early hours, the entire market yard is lighted with a special system of electroliers, making it possible easily to make small change, and read the smallest print.

Altogether there are 36 Mazda C lamps of 300 candlepower each. They are supported at a height of approximately 30 feet by tubular steel posts five inches in diameter and tapering towards the top, which is arranged as a flagstaff. The posts are set in four feet of concrete. They are set in line with the fence that marks off the stalls for the farmers. This fence consists of iron pipe supported by wooden posts. The steel lamp posts connect with the horizontal pipe and take the place of the wooden posts; they are filled with concrete up to a point level with the fence pipe in order to strengthen the portion up to about 3 feet above ground where the greatest bending force is exerted. The iron pipe running along the top of the fence acts as a conduit for the electric wires leading to the lamps. This arrangement saved the expense of putting in an underground conduit connecting the posts. The lamps on each post can be switched separately or all collectively from the main switchboard.

Night View of Lighting of Market Court, Los Angeles Terminal Market. Photograph Was Taken at 4:30 A. M.



Close View of Typical Combination Double Lamp Post, Flag Staff and Fence Support.

Motors for Various Uses in Market Buildings.

This market is the first unit of a great terminal that is nearing completion. When the proposed plans are fully carried out, this will be the second largest terminal in the United States. The remaining structures are all six-story buildings, and will be occupied by manufacturing and wholesale concerns. These buildings will be equipped with an elaborate system of flood lighting. Electric motors aggregating approximately 2000 horsepower will be employed to drive various machinery that is being installed in these six-story buildings.

Fourteen electric motors, ranging from 10 to 150 horsepower and totaling 340 horsepower, are now operating one of the largest and most modern refrigerating plants in the West, this plant being an integral part of the terminal. The motor control panels are of special design for this installation. Each has various instruments and switches for remote control oper-

ating of the various machines throughout the plant. These consist of circulating pumps, water pumps, air compressors, ventilating fans, ammonia machines, etc. This plant occupies 250 feet of one of the six-story buildings and extends from the basement to the roof.

For more than a year, one of the largest firms in Los Angeles has been studying the methods of all the leading bakeries in the country, with the result that it is installing in the terminal a new plant that embodies the latest and best features of all. These include flour blenders, bread mixers, conveyors, automatic wrapping machines, all of which will be operated by electric motors. One of the largest candy manufacturers will also move to this terminal, and will employ electric motors for operating all machinery. Space and electric power will be rented out to many smaller concerns, who will occupy the terminal.

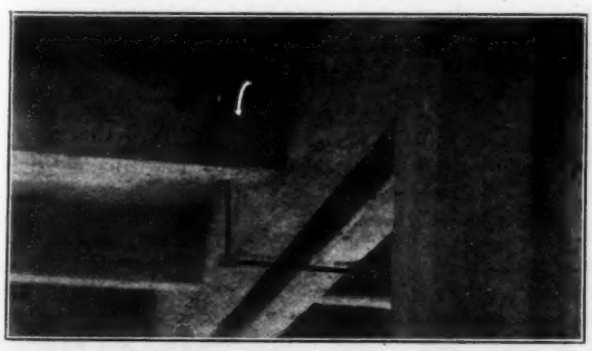
Many of the produce firms in the market have installed elaborate systems for ripening bananas. This will be done by electrical heaters, as the elimination of gas for this purpose is now being advocated. All railway freight switching service at the terminal is performed by electric locomotives, giving efficient, noiseless and cinderless switching. These locomotives, ranging from 300 to 1000 horsepower, give both day and night service, there being more than two miles of switch tracks.

Two large water reservoirs under the market yard, with a capacity of 75,000 gallons of water each, are maintained for fire protection and the automatic sprinkler system. Between the two reservoirs there is an underground pump house with two electric fire pumps operated by 75-horsepower motors with automatic electrical control. The electricity that operates these motors comes from a central transformer room and passes through a double-throw switch. In addition to the regular service transformer there is another set of transformers that get their supply from an entirely separate source. This system of fire protection has received the highest approval from the fire underwriters. There are 35 miles of pipe lines and 20,000 sprinkler heads included in the automatic sprinkler system.

Features of Electrical Installation Work.

The electrical work in connection with the terminal is so large in volume that the electrical contracting company engaged on the work maintains an office and large supply of electrical equipment in the terminal. It has been estimated by the electrical contractor that there are 8000 miles of electrical wiring in the terminal. For the telephones alone there are 400-pair cables running the full length of each building in the basement, with taps conveniently located.

There is an interesting feature in connection with the expansion joints of the electrical conduits in the six-story buildings. There are two expansion joints on each floor of each six-story building. A space of two inches is left between the columns at these joints for contraction and expansion of the building. Where the electrical conduits pass into these expansion joints two pull boxes are provided, with the horizontal pipe connecting the two boxes arranged to contain a slip joint, which will allow the building to expand two inches without interfering with the conduit. A few weeks ago when Los Angeles was rocked by an earthquake the building expanded nearly two inches at these joints, without doing any damage to the electric wiring. This would have broken the wiring and crippled the electrical service, had it not been for this precaution.



Expansion Joint Between Pull Boxes of Electric Conduit in a Long Concrete Terminal Building.

EXTENSIVELY DEVELOPED MOTOR REPAIR BUSINESS.

The Meier Electric Company, of Indianapolis, Ind., in operating a general electrical repair shop, has developed a range of business almost nation-wide, due largely to the fact that it has succeeded to the repair work on Jenney motors. High-voltage tests are made on all armatures, and one of its specialties consists in the manufacture of flexible insulation for armature winding, the insulation resisting acid, water and gas. The increase of armature heat does not affect the flexibility of this insulation. Specially prepared, gas-heated ovens are in use for producing this type of insulating material. The company engages in electrical contracting also, its work being confined largely to installations of electric power equipment in mills and factories.

AMONG THE CONTRACTORS.

The E. J. Electric Installation Company, 221 West 33rd Street, New York City, has been awarded the contract for installing a new fire-alarm system at Hampton Roads, Va. The amount of the contract is $8024.

The United Electric Construction Company, 1727 Sansom Street, Philadelphia, Pa., has received the contract for installing an automatic telephone system in the general storehouse of the Navy operating base at Hampton Roads, Va., the contract price being $14,748.

The McEachern Shipbuilding Company, of Astoria, Ore., is making rapid progress in the installation of the new electrical equipment to be used in connection with its shipbuilding plant. The M. J. Walsh Electric Company, of Portland, Ore., is the contractor.

The Hatfield Electric Company, Indianapolis, Ind., installed 30 Westinghouse direct-current motors, amounting to 1700 horsepower, in the works of the Rex Manufacturing Company, Connorsville, Ind., in the early part of the year. This was an installation in which steam power was completely replaced by electric drive, practically each machine in the plant being driven by an individual motor through belt transmission. The Rex company's business, primarily, is the manufacture of vehicles, but it has in hand government contracts for which speedy equipment was required. The Hatfield Electric Company also early in the spring extended the necessary power lines from Indianapolis to big aviation field, nine miles out, for supplying electric energy to operate 35 motors used in the repair shops. This is one of the centers for airplane repairs and motor testing.

QUESTIONS AND ANSWERS

All readers are invited to submit questions and answers to this department. Anonymous communications will not be considered. Questions should relate to electrical matters of any kind. Answers contributed by readers should be submitted preferably within eight days of the date of publication of the question and should be limited, if possible, to 300 words. Payment will be made for all answers published.

Questions.

No. 430.—Reducing Noise of Elevator Controller.—The machinery and control panel for an electric elevator in a small hotel are located at the top of the open shaft, directly above the fifth or highest guest floor. Guests occupying rooms on this floor close to the shaft complain of the noise made by the controller switches, which are of the clapper magnet type. The elevator operates very satisfactorily except for this annoyance. What can be done to stop it? Can another type of switch be used on the controller?—T. N. S., Austin, Texas.

No. 431.—Relieving an Overloaded Transformer.—A 25-kilovolt-ampere three-phase transformer supplies power to a plant that is now running night and day. The transformer is overloaded as much as 15 to 20 per cent at times and is now running close to dangerous temperature. It is a 60-cycle, oil-insulated, self-cooling type stepping down from 2300 to 230 volts, and is placed in a remote and cramped corner of an old engine room. It is impossible to shut down the plant except on Sunday. A larger transformer has been ordered, but delivery is not promised before six months. What may be done in the meantime to relieve the transformer?—J. S. C., Minneapolis, Minn.

No. 432.—Ampere-Hour Meters in Place of Watt-Hour Meters.—Now that public service commissions are insisting on voltage regulation within a few per cent from a standard, such as 115 volts, would it not be a fair plan to allow central-station companies to install ampere-hour meters instead of the now standard watt-hour meters for new residence and other small customers? How much saving in meter and wiring expense would be obtained per customer? Would this eliminate the meter losses on light loads?—A. F. B., New York, N. Y.

Answers.

No. 423.—Iron Bars for Busbars.—An order was received for a new switchboard containing voltmeter, ammeter, main switch (fused for 400 amperes), ground lamps, pilot lights and four circuit switches. Being unable to obtain copper for the busbars, flat iron was used, having seven times the cross section of the intended copper, with joints scraped and bolted together. The board was inspected and passed by the local inspector under Rule 2, section *b*, second paragraph, of the 1915 Code. Several weeks later this same inspector called and stated his office claimed all busbars must be of pure copper, and that the inspection department would not approve a substitute that might start a bad practice among contractors and switchboard builders. Reference was made to rules 18, 49 and 57. In none of these rules is it stated that conductors must be made of copper, only in Rule 18 it shows the carrying capacity of wires and cables of 98 per cent conductivity. The firm using this switchboard is working on special war orders for the Government and if unable to get a ready-made board or copper busbars must shut down or pay hazardous insurance rates. I would appreciate opinions from some authority on this subject, as it has been impossible to obtain satisfaction from the electrical engineer of the underwriters.—L. G., Dubois, Pa.

[For Answers *A*, *B* and *C* see Electrical Review of April 27, 1918.]

Answer D.—One of the largest electrical manufacturers of switchboards in this country is now, to my personal knowledge, using mild-steel bars and tubes for buses for direct current of any amperage and up to 10,000 amperes alternating current. The buses are given a heavy copper plating and, except for size, cannot be distinguished from copper. Up to 1200 amperes the bars are bolted and above this clamps are used. All joints are sweated. The capacity for direct current is about three-eighths of similar copper buses. It is probable that the inspection department in your district is not keeping in touch with the latest developments that have taken place in the past two years.—H. E. W., Chicago, Ill.

No. 427.—Storage Battery for Exit Lights.—A storage battery is provided as an emergency source for the exit lights of a theater, which is normally supplied from the central-station lines. The battery is to be charged by a small special motor-generator. The house electrician has been advised to charge the battery once a week, even though it is practically never connected to the lights. Is this not excessive? How often is it advisable to charge the battery under these conditions?—J. B., Newark, N. J.

Answer A.—It is advisable to arrange, if possible, to keep your house battery on a small discharge constantly. It is not good policy to allow any storage battery to stand on open circuit for any great length of time, and especially one to be called on in case of emergency, as your battery would no doubt be. This can be arranged by connecting to this set of cells a pilot lamp or two of sufficient size to take a fair current proportionate to the size cells or rate of charging current. This will also give you a line on the one very important point—the condition of the battery. When it is called upon for the purpose for which installed, you will find the equipment "on the job" and in good condition. Once a week is correct for recharging, provided, as stated above, you take out a reasonable portion of a discharge. As an alternative, I would suggest a daily test, but by using a special pilot lamp on your discharge, as above, and noting if it is always burning, you then know everything is O. K.—F. F. H., Milwaukee, Wis.

Answer B.—When a storage battery is not in actual use it requires just as thoughtful care as when it is performing its functions, since a battery standing idle is slowly but constantly discharging itself. This self-discharge is due partly to a chemical action of the acid on the impurities in the plates and paste, partly to sulphation and partly to the surface leakage. To charge a battery once a week is excessive. In the course of a week there cannot be enough self-discharge to materially weaken a well made battery and, therefore, to charge a battery in this condition is only subjecting it to excessive wear and tear, thereby shortening its life. It has been found by battery experts that a storage battery that is idle will remain in good condition if charged once a month. This is true whether it is used for exit lights or whether it is the storage battery of an automobile that is stored over winter.—T. D. S., Cleveland, O.

Answer C.—The manufacturer or the engineer ordering the installation should know better than any one else, not on the job, as to how often to give a charge to an idle battery. It is usual, however, to give this charge about every two weeks and charge at a low rate. It will be found advisable to discharge the battery to one-half or two-thirds capacity every one or two weeks in order to prevent the battery becoming "sluggish." This is especially necessary where in order to use a small emergency outfit the battery is discharged at the three or five-hour rate during such an emergency. The best plan as regards battery maintenance and operation would be to use the battery for lighting once each week till the battery was about one-half discharged and then pull it off and charge at a low rate, giving a slight overcharge.—H. E. W., Chicago, Ill.

Answer D.—Storage batteries should not be kept idle for extended periods, and it is considered good practice to take a battery out of commission entirely

if it is to remain idle for 45 days or more. For an emergency service battery it is general practice to give a light weekly charge in order to keep the cells fresh, even though the battery has not been used. The results, however, would not be very different if the charge were given once in two weeks. Battery plates are somewhat similar to the human lungs in their action, and once installed they should be kept working in order to maintain a long and useful life. An idle battery will gradually discharge itself on account of local action and leakage. In the present instance, where a motor-generator set is available it would be well to connect the battery to the lamps one day every week, for three or four hours, and then to overcharge at low rate in order to cause gasing; this will stir up the electrolyte and tend to even up the voltage of the cells. Generally speaking, storage batteries will last longer if they are kept active, provided the charging and discharging rates are not excessive.—C. H. H., Swampscott, Mass.

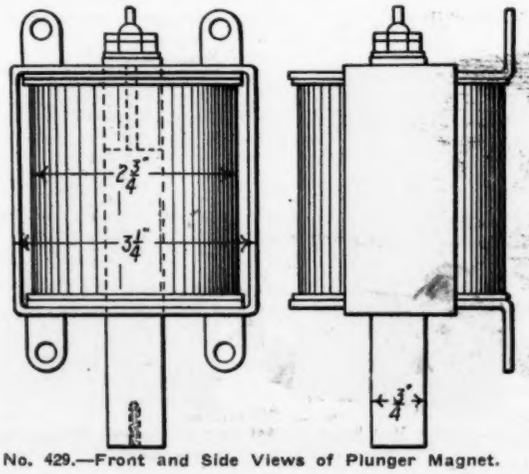
Answer E.—The necessity of charging a storage battery is, as a general rule, determined by the amount of current which has been drawn from the battery. This is ascertained by means of a hydrometer, with which it is possible to determine with a fair degree of accuracy the extent of the chemical change which takes place in a storage battery when current is drawn from it. From the foregoing it can readily be seen that what really determines the necessity of recharging is the chemical change which takes place in the battery, which change is brought about by current being drawn from the battery and thus the plates or by any means wherein electricity is drawn from the plates. In all lead storage batteries it has been found that it is practically impossible to prevent the plates from what is termed "self-discharging," that is, giving off current through the electrolyte even when the battery is not in use, which causes practically the same chemical action which takes place when the battery is discharged normally. To make this clearer, it must be understood that the plates in a lead storage battery are made up of peroxide of lead (PbO_2) for the positive plates and sponge lead (Pb) for the negatives, which on discharge are changed to lead sulphate ($PbSO_4$), this chemical action taking place when a current of electricity is drawn from plates of this description immersed in a solution (electrolyte) of sulphuric acid (H_2SO_4) and water. Since the amount of SO_3 which is drawn from the acid is directly in proportion to the chemical change in the plates it is therefore possible to determine the condition of charge of the battery by the specific gravity of the electrolyte, which varies indirectly in proportion to the amount of SO_3 which is drawn from the solution. Under ordinary conditions it has been found that the average lead storage battery loses but a very slight amount of current in one week's time, but loses from 10 to 30 per cent of its charge in 30 days. The proper rate to charge a battery so as not to cause deterioration of the plates should be until the voltage of each cell rises to 2.5 or slightly higher and the cell has been gasing previously for about an hour. This rate for the ordinary type of battery is approximately 1/40 of an ampere per square inch of positive plate surface, figuring both sides of the plate. Under conditions described in the question, the battery should be charged every 30 days for a period of from 4 to 8 hours at the rate already stated, provided the temperature of the electrolyte in the battery does not rise over 110 degrees Fahrenheit in which case the charging must either be discontinued or the rate reduced one-half. If the battery is used, it should be recharged within two or three days afterwards, depending on the amount of discharge, as, if the battery is allowed to stand in a discharged condition even for a comparatively short time, injurious sulphate will be formed which it will be very hard to remove by charging. The rate herein described for charging is known as the 24-hour rate for automobile starting and lighting batteries.—W. K. F., Lakewood, Ohio.

No. 428.—Condenser for Motor Starting.—Can the starting current of a squirrel-cage induction motor be reduced by using a condenser when the compensator does not keep it from becoming so large that it is objectionable? What way would it be connected and how large would it need to be for a 100-horsepower, three-phase, 440-volt, 25-cycle motor?—J. A. B., Fort Dodge, Iowa.

Condensers could only limit the current taken from the line by reducing the wattless component. The wattless component of an induction motor at starting, although quite large, is still such a small part of the total starting current that condenser would not help much. It is possible that the compensator is tapped off at too high a voltage. If this is so it will be only necessary to use a lower tap. It is also possible that some of the turns of the compensator coils may be short-circuited. For a machine of this size I would recommend automatic starting with, for instance, the automatic compensator as made by the Electric Controller & Manufacturing Company.—H. E. W., Chicago, Ill.

No. 429.—Plunger Magnet.—Information is desired on the construction of a solenoid or plunger magnet to operate on 16 volts and 1.5 amperes on a 60-cycle circuit almost continuously. The stroke is to be about 1 inch, if possible, and with all the pull that we may get. The pull will close a connection heavy enough to carry 5 amperes on a 110-volt circuit. The size of the magnet is not of any consequence.—F. H. O., Chester, Pa.

It is a mistake to use as low a potential as 16 volts for this proposition if a higher electromotive force is available. For alternating-current magnets, to prevent chattering and to insure uniform pull, it is necessary to place a shading coil, which is a ring of solid copper, in the end of the plunger or in the stop. The amount of pull the magnet is to be designed for must be determined beforehand, as a 5-ampere contact for voltages less than 300 may vary in pull from a few ounces to several pounds, depending entirely on the mechanical design. Using a condenser with the magnet one could be designed for 16 volts having frame dimensions as per the accompanying diagrams. This frame is a standard one and could be purchased without winding, if desired.—H. E. W., Chicago, Ill.



No. 429.—Front and Side Views of Plunger Magnet.

New Appliances

Armature Control Rheostats—Automatic Starter—Warren Frequency Control by Clock System—Convertible Lantern

WARD LEONARD ARMATURE SPEED CONTROLLERS.

For many purposes it is desired to control the speed of a small direct-current motor by means of an adjustable resistance permanently inserted in the armature circuit instead of, or in addition to, regulating the speed through a resistance in the shunt-field circuit. The latter increases the speed above normal, whereas resistance in the armature circuit decreases the speed below normal. Since such resistance must be able to carry the full armature current continuously, the rheostat used for this purpose must have ample current-carrying and heat-dissipating capacity.

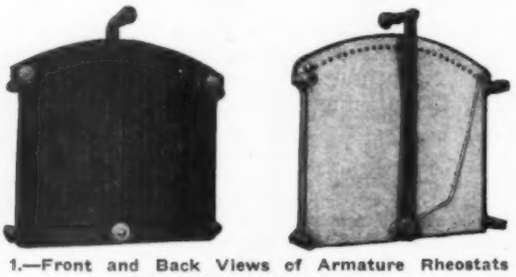


Fig. 1.—Front and Back Views of Armature Rheostats for Motors Up to 2 Horsepower.

As the result of the ripened experience of over a score of years in building rheostats for various purposes, the Ward Leonard Electric Company, Mount Vernon, N. Y., has placed on the market a line of improved speed controllers for use in motor-armature circuits. These controllers are of the plain, adjustable resistance type with the resistance imbedded in specially enamelled plates; the resistance element has the same ampere or current-carrying capacity throughout. The face of the plate has ribs to stiffen it against expansion stresses and to provide additional radiating surface. An especially durable and somewhat elastic enamel is used for imbedding the resistance wire.

These controllers are made in two forms, the face and back of each of which is illustrated herewith. The type shown in Fig. 1 is made in 19 ratings for dissipating from 75 up to 1280 watts on continuous duty, whereas the type illustrated in Fig. 2 is made in 28 different ratings for taking care of 1920 to 12,800 watts. The former rheostats are suited for speed control of motors from 1/16 to 2 horsepower, and the latter for motors from 3 to 20 horsepower. Motors of 70 to 500 volts are thus provided for by rheostats with current capacities ranging from 0.35 to 320 amperes and resistances from 1200 ohms to 0.12 ohm.

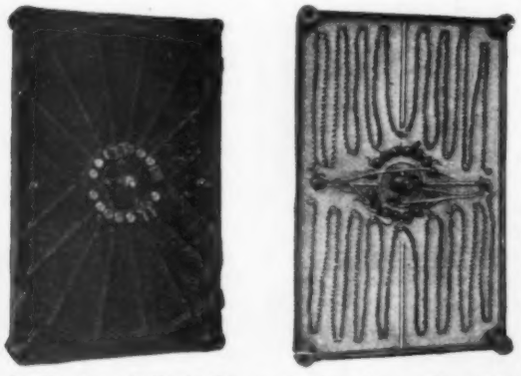


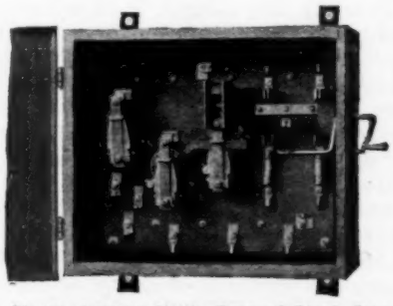
Fig. 2.—Front and Back Views of Armature Rheostats for Motors of 3 to 20 Horsepower.

These rheostats also can be used for many other purposes, such as for battery charging, projector lamps using the new Mazda lamps, static machines, etc.

A PRESSED-STEEL AUTOMATIC STARTER.

The advantages of automatic control for machine tools have been so persistently preached by the motor and control manufacturers that it is doubtful whether there remain many operators who are not fully convinced that this type of control is both economical and productive. This kind of starting gives the operator a sense of relief to know that he need not face the possibility of injuring the motor, or his machine, by improper starting. It permits him to concentrate his attention on the work on his machine, and thus gives a greater output of the finished product.

The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has been building automatic starters for many years and is now marketing a small compact starter, specially adapted for direct-current motors of 10 horsepower and less.



Automatic Motor Starter With Pressed-Steel Case. Door Opened and Only Partly Shown.

The complete controller is entirely inclosed in a dustproof case, approximately 15 inches high, 17 inches long and 10 inches deep, which may be locked to prevent unauthorized persons tampering with the switches. The line knife switch is operated from the outside of the case by a crank handle extending through one end, thus protecting the operator from current-carrying parts. The switch may be locked in the off position, if so desired.

The counter-electromotive-force method of acceleration is used, and as the time of acceleration is dependent on the motor load, positive protection against too rapid acceleration is assured.

Experience has shown that in all ordinary services, motors up to 15 horsepower require only two points of acceleration, and these are obtained in this starter by the use of only one accelerating contactor. Where the starting is exceptionally heavy, as in the case of machine tools with large flywheels, positive pressure blowers, or long line shafting, two accelerating contactors are used, giving three points of acceleration.

The main parts of the contactors are made of pressed steel, thus combining great strength, uniformity and light weight. Provision is made for either conduit or open wiring through the top, bottom and end of the case opposite the switch handle.

These starters are provided with protection against failure of power, and may be so arranged that either the motor will be restarted automatically when the power returns, or it will require the service of the operator to start it again. The latter arrangement is used for machine tools and similar applications where the unexpected starting of the machine might cause injury to the machine or to its operator. The former method is applicable where it is desired to have as little interruption of the service as is possible, as in the case of pumps, compressors and like services.

By using pressure gauges or other automatic devices in connection with these starters, automatic service may be obtained, and continual operation provided, without any attendant. The starters are built both with and without provision for dynamic braking and may also be used with a field rheostat for adjustable-speed service.

THE STANDARDIZATION OF FREQUENCY.

Description of the Warren Duplex-Clock Frequency-Control System.

By Henry E. Warren.

Many large power plants and systems have been designed and built without a view to the need of interconnection or even consolidation with other systems, especially at a critical time like the present. Consequently the important element of uniform frequency has not been given sufficient weight. There are today in regular operation in the United States very many power plants operating at each of the following nominal frequencies: 25 and 60 cycles. There are also a few plants operating at other nominal frequencies, such as 30, 40 and 50 cycles. By far the greater number of power companies, however, intend to operate at 60 cycles. The word "intend" is used advisedly because investigation has shown that very few plants are actually operating at exactly the frequency which has been selected.

Most power and electric light companies are actually sending out alternating current which is more than 1 per cent higher or lower in frequency than they suppose. The error is due to the instruments which are in use and particularly to the effect of temperature changes upon these instruments. It is also accounted for in part by the present methods of adjusting the frequency.

In order that power companies may be linked together, it is of course necessary that they should operate at absolutely the same frequency unless frequency changers are employed, which would not be generally feasible. One station sending out current at 60 cycles could not be tied to another which was running at 59½ cycles. Before they could come together it would first be necessary for the former to drop or the latter to increase its speed. As a result, after they were united, the operators at one station would probably declare that the frequency was low, or at the other station that it was high. If a third station should join, it would be necessary to raise or lower its frequency according as its frequency meter happened to read high or low. Every new station added to the system would face the same problem of readjustment of its own frequency to meet that of the system. Every time a station disconnected from the system and attempted to run at its own normal value all of its customers would be affected by the change.

Obviously this condition is wasteful and troublesome. It leads especially to friction among the operators of the different stations who are inclined to believe their own instruments and to object to raising or lowering their frequency to meet the value established by someone else whose instruments they naturally doubt. As the output of all electrically driven machinery depends directly upon the frequency, it is

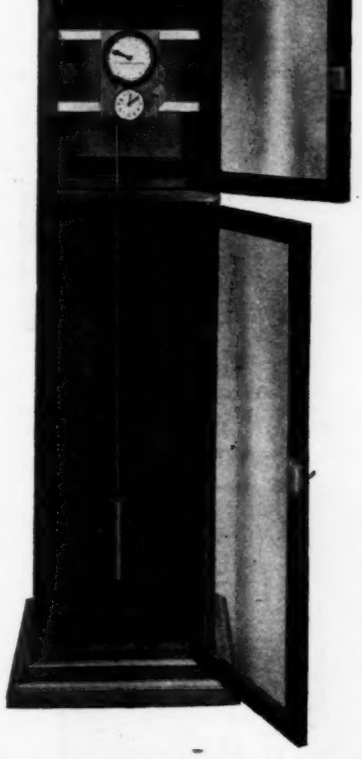


Fig. 1.—Warren Master Clock. Built by the Warren Clock Company, Ashland, Mass.

evident that an increase or decrease of frequency, even as small as one per cent for the purpose of operating in multiple with other power stations, is by no means insignificant.

Since all ordinary frequency meters are very decidedly affected by temperature changes, it is evident that the frequency itself, which is regulated by means of these instruments, must be equally affected. In other words, the average value of the frequency is different on a cold day from that on a warm day. This means that the output of all electrically driven mills is influenced by the temperature.

There is now coming into use rapidly in the eastern part of the United States a new method of regulating the frequency which eliminates all of the diffi-

culties heretofore mentioned and makes it possible to operate any number of stations at the true average value of the normal frequency without any error that is measureable. Consequently, it is an exceedingly simple matter for power companies equipped in this manner to connect with one another or run independently without in the least disturbing the frequency of the current supplied to their customers and without involving any differences of opinion among their operators. This method of controlling the frequency will easily reduce errors in its average value to less than one per cent of those which are commonly found today. Furthermore, this very desirable result is reached with the expenditure of less attention on the part of the operators. The method may be described as follows:

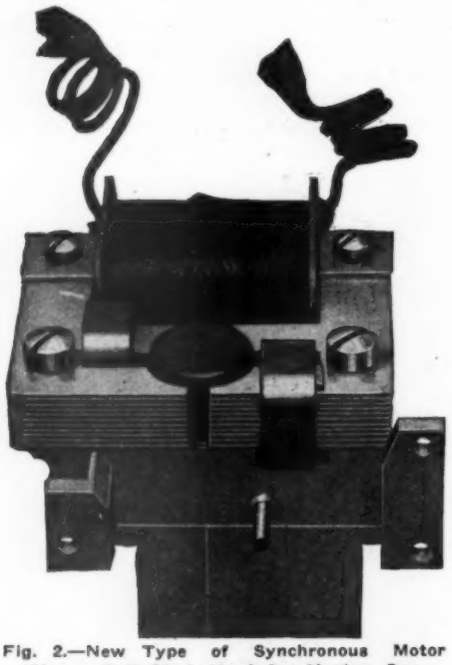


Fig. 2.—New Type of Synchronous Motor (Shown Full Size) Used for Moving One Second Hand of Master Clock.

Fig. 3.—Warren Secondary Clock Operated by Synchronous Motor Shown Above.

starting synchronous motor, illustrated full size in Fig. 2. There are two second hands on the large upper dial of the clock, which is 5 inches in diameter. One of these hands is black and connects with the pendulum so that it registers true time. It can be depended upon to run within one-half second per day when properly regulated. The other second hand mounted upon the same center and revolving over the same dial is gold color and receives its motion from the Warren motor. This motor, which requires only two watts for its operation, is connected to any instrument transformer that is always in circuit. Therefore, the gold second hand on the master clock integrates

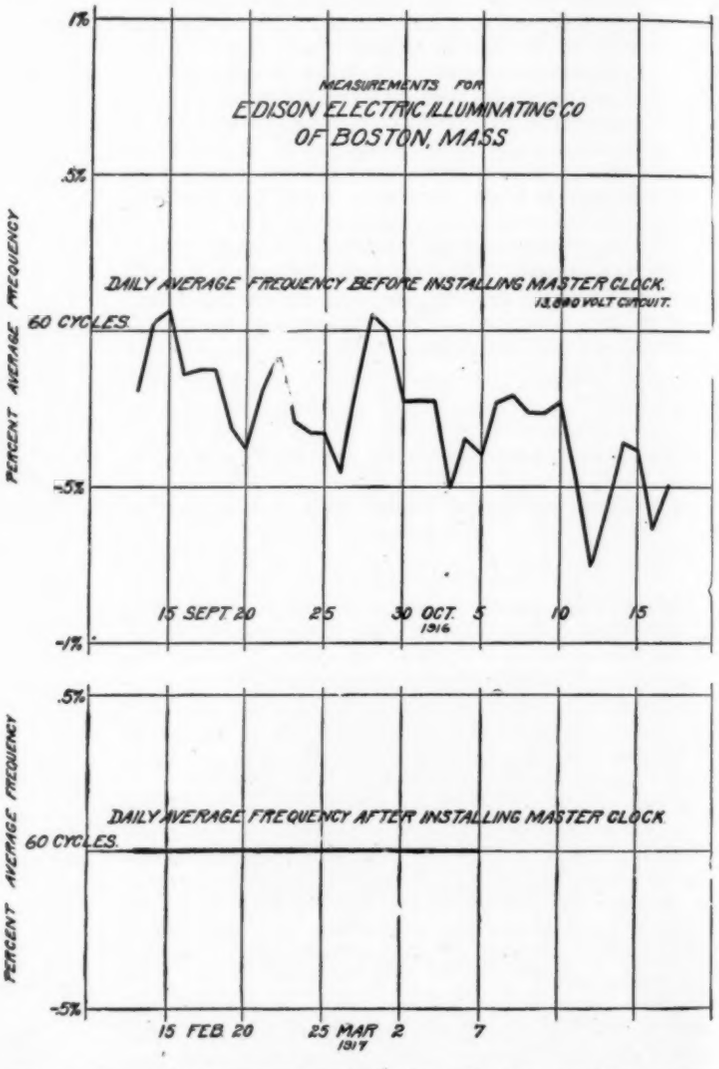


Fig. 4.—Record of Average Frequency Before and After Installing Warren Frequency-Control System.

or counts the alternations of the current, since it is directly geared to a synchronous motor, or in other words this gold hand moves at a rate depending entirely upon the frequency of the current.

If the average value of the frequency of the current is exactly normal, the gold hand will move just as fast as the black hand and they will constantly remain together. But if the frequency is above normal the gold hand will keep gaining over the black hand, and conversely if the frequency is low the gold hand will lose and fall behind the black hand. The operator on

Description of the Warren System.

There is located near the switchboard, and within view of the operator on duty, what is designated as a Warren master clock, shown in Fig. 1. This clock contains two complete movements, one accurately controlled by a pendulum, having an Invar rod and deadbeat escapement, and the other by a Warren self-

duty is instructed to adjust the speed of the turbines from time to time by means of his speed control switches, if he finds that the gold hand on the clock is tending to vary from the black hand.

Experience has shown that in a large power station the frequency will, when once adjusted, remain very close to its true value, and the gold hand on the clock will not deviate from the black hand more than a second or two in a half hour. Therefore it is not necessary for the operator to make as frequent adjustments as he has been accustomed to do with ordinary frequency meters. This is because the common type of frequency meter shows only the instantaneous value of the frequency and this may be momentarily high or low, depending upon instantaneous load changes. It is obvious that a correction should not be made because of a condition which is only momentary, and yet the operator has had no other guide. Therefore many of the corrections which he has made are worse than needless.

With a Warren master clock in use corrections are not made unless there is a positive and long-continued tendency for the frequency to run high or low. Momentary fluctuations in frequency are not apparent at all on the dial of the clock. This master clock is kept wound at constant tension by the same motor which drives the gold hand. Thus no attention whatever is required from the operator except to check up the clock from day to day, preferably by comparison with Washington time signals, and to regulate it occasionally. It has been found in practice on large systems that when the frequency is controlled in this manner its average value as measured over a 24-hour period can readily be held within one five-hundredth of one per cent of its true value, and this result is independent of temperature, because the pendulum of the clock is made of Invar, an alloy of almost negligible temperature coefficient of expansion.

Obviously, any number of power stations which are thus controlled can easily be joined together without the least disturbance. This method of regulating frequency, while it greatly simplifies the problem of parallel operation for power stations running at the same nominal frequency, does not take care of those stations which for some reason or other have chosen to run with an eccentric value of frequency; for example, there are some stations which deliberately run as much as two or three cycles above or below the 60 cycles which is becoming standard. There seems to be no way to accomplish the pooling of their resources except by their making concessions so as to meet the accepted standards.

For those stations which are operating at very different frequencies, as, for example 25, 30 or 40 cycles, the only method of connecting with a general network is obviously through frequency changers, and this will probably be worth while eventually.

Use of Warren Secondary Clocks.

It is exceedingly easy to demonstrate when the frequency is exactly right, because then any number of secondary clocks which are driven by the same type of synchronous motor as the master clock may be distributed through the buildings, and these clocks will show correct time continuously. They look just like ordinary clocks (see Fig. 3) but their mechanism is entirely different. They require neither winding nor regulating and usually they are so arranged as to be kept running by auxiliary mechanism even if there should be a short interruption of the current. The fact that these clocks are on time is sufficient proof to satisfy anyone that the frequency at least is right and any shortage in production of a mill must be charged to some other cause.

The question will arise whether it is feasible to control the frequency so accurately that such clocks can be generally used all over any system of distribution. The answer is direct and positive. It is being done continuously month after month by great distributing systems around Boston, New York and other cities and the amount of attention required is far less than when the frequency was regulated by means of ordinary frequency meters. Fig. 4 shows at the top an irregular curve recording the average daily frequency for a period of one month in the autumn of 1916 on the Boston Edison system before the Warren master clock was installed, and the straight horizontal line below shows on exactly the same scale the daily average frequency during the month after the Warren master clock was installed. This same horizontal line is maintained month after month without showing any deviation great enough to be visible on this scale. Hundreds of secondary clocks are now in use on this same system, and the service which they give is unequalled by any other type of clock. This fact is another argument for adopting this method of frequency control, because it adds a new kind of value to the ordinary electric light service.

There is still another reason for adopting the new method of controlling frequency. It makes feasible the use of graphic and other recording devices and time switches driven continuously and unerringly by means of the same kind of synchronous motors that drive the master clock. Frequently this means a great saving in labor and much more accurate results. The great success which has been obtained so far by these new devices for regulating the frequency, and the interest which has been aroused wherever the system has become known indicates strongly their general and prompt adoption by all large power companies.

CONVERTIBLE ELECTRIC LANTERN.

A new form of electric lantern that can be operated on any standard flashlight dry battery has been placed on the market by the Lindstrom, Smith Company, Chicago, Ill. It is quite compact, having over-all dimensions of only 6 by 5½ inches. The case is made

White Cross Convertible Electric Lantern.

of heavy metal thoroughly nickel-plated. A standard low-voltage tungsten lamp is used; it is protected by a wire guard. A bail serves as a handle and the hook on it permits it to be hung on a rod, nail or hook. The bail can be rotated so that the lantern may be turned to any angle desired and carried upwards, downwards or sideways. This convertible feature makes the outfit extremely useful for a great variety of purposes in all places where an extension light from a regular lighting circuit is not available. When used with a No. 610 Columbia dry cell, it will give about 20 hours' continuous service, or about 40 hours' intermittent service. A new battery can be quickly inserted and requires no wiring since it makes contact through springs in the bottom of the case.

Current News

Weekly Record of Construction Activities—Conventions

EASTERN STATES.

WORCESTER, MASS.—W. H. Sawyer Lumber Company, 66 Lincoln street, has awarded a contract for the erection of the proposed new addition to its boiler plant, in connection with other additions to its works. L. Rocheford & Son, 44 Front street, Worcester, are the contractors.

BRIDGEPORT, CONN. — Contract has been awarded by the United Illuminating Company, 1115 Broad street, for the proposed one-story brick building, about 51x80 feet in dimension, to be erected at its plant. Casey & Hurley, 120 Pequonnock street, Bridgeport, are the building contractors.

ALBANY, N. Y.—Contract has been awarded to Gagen & Butler, Inc., 1402 Broadway, New York, for the electrical work in connection with laboratory constructed by the State Board of Health. The contract price was $10,484. Dr. Herman M. Biggs is State Commissioner of Health, Capitol, Albany.

BROOKLYN, N. Y.—Edison Electric Company, 360 Pearl street, has awarded a contract for the erection of a new one-story addition to its plant on Gold street, and alterations and improvements in the existing structure. John H. Duncan, foot of Sixty-sixth street, Brooklyn, is the contractor.

BUFFALO, N. Y. — In connection with the large new plant being erected by the Linde Air Products Company at Broadway and Ideal streets, plans have been prepared for a one-story switchboard building, of brick and reinforced concrete construction. The entire work is estimated to cost $60,000. J. W. Cowper, Inc., Fidelity building, Buffalo, is the contractor.

BUFFALO, N. Y.—Buffalo General Electric Company, Electric building, has had plans prepared for the construction of a one-story brick addition, about 95x106 feet, to its substation on Staats street. The structure is estimated to cost $17,000.

BUFFALO, N. Y.—Cousins & Sons, 74 Wabash street, have awarded a contract for the erection of a new one-story brick boiler plant, about 20x35 feet, at Hopkins and Tifft streets. B. I. Crooker, 57 Builders Exchange, Buffalo, is the contractor.

DEPEW, N. Y.—Plans are under consideration by the Gould Storage Battery Company for the construction of a two-story brick and steel addition to its plant, to provide for increased capacity. The structure will be about 75x90 feet in size.

FAIRPORT, N. Y.—Douglas Packing Company has had plans prepared for the erection of a new one-story brick, steel, and concrete addition to its power house, about 50x76 feet, to be located on John street. A. S. Crocker, Mechanics Institute, Rochester, is engineer.

WARSAW, N. Y.—Warsaw Elevator Company has had plans prepared for the erection of a one-story addition to its power house. C. E. Ketchum is president.

DOVER, N. J.—New Jersey Power & Light Company is planning to commence work at once on the construction of extensions to the plant of the Atlas Powder Company at Landing, to cost about $5,800, to provide power for the operation of the works. A connected load of about 300 kilowatts will be required, and about 150,000 kilowatt hours per month will be used.

NEWARK, N. J. — Essex County Board of Freeholders has awarded a contract to Henderson & Company, 835 Springfield avenue, Irvington, for the installation of the proposed heating system in the County Hospital at Overbrook, at $39,520.

PARK RIDGE, N. J.—Park Ridge Lighting Company has recently been ordered by the Board of Public Utility Commissioners to make various improvements in its system.

PLAINFIELD, N. J.—Niles-Bement-Pond Company is making rapid progress in the construction of a boiler plant in connection with the large new works of the company now being erected at a cost of about $500,000.

TRENTON, N. J.—New York Telephone Company has filed with the Board of Public Utility Commissioners a new schedule of toll rates, to become effective July 1, to meet the requirements of an order recently handed down by the board. The new schedule will affect an annual reduction in revenue of about $800,000.

CARLISLE, PA. — Carlisle Light, Heat & Power Comany has filed notice with the Public Service Commission of an increase in its rates for service.

GREENVILLE, PA. — Notice has been filed with the Public Service Commission by the Mercer County Light, Heat & Power Company of an increase in its present rates for service.

PHILADELPHIA, PA. — Bellevue Worsted Mills, Wister street and Reading Railway, have awarded a contract for the construction of a one-story brick power house, about 30x89 feet, to be located at Sixteenth and Hunting Park avenues. The structure will cost $10,000. W. E. S. Dyer, Land Title building, Philadelphia, is the contractor.

PHILADELPHIA, PA.—Bethlehem Steel Company has had plans prepared for alterations and improvements in its power plant at McAfee, N. J. A new addition will also be erected to provide for increased capacity.

PHILADELPHIA, PA. — Germantown Steam Company, 349 West Hortter street, has awarded a contract for the proposed new addition and improvements in its heating plant at Pelham Road and Hortter street. Wilbert C. Springer, 1624 West Latimer street, Philadelphia, is the contractor.

PHILADELPHIA, PA. — Philadelphia & Reading Railway Company, Reading Terminal, has had plans prepared for the construction of a two-story brick, stone and concrete signal tower and battery building at Manville Junction, N. J.

PHILADELPHIA, PA.—Bell Telephone Company, Seventeenth and Arch streets, has awarded a contract to F. L. Hoover & Son, 1023 Cherry street, Philadelphia, for alterations and improvements in its one-story telephone building at 26 West Chelten avenue.

LANCASTER, PA. — Pennsylvania Power Company is contemplating the construction of another dam at Turkey Hill for another water power plant.

PHILADELPHIA, PA. — Pennsylvania Range & Boiler Company, 2024 North Tenth street, has had plans prepared for the erection of an addition to its plant and improvements in the existing works.

BALTIMORE, MD. — Baltimore County Water Company, 100 West Fayette street, has awarded a contract for the construction of a new pumping plant at Falls Road and the viaduct. The Price Construction Company, Maryland Trust building, Baltimore, is the contractor.

RUTLAND, VT.—Rutland Railway, Light & Power Company is considering new additions and extensions in its system to provide for increased capacity. It is said that the majority of the steam users located in this territory will change the motive power of their respective plants to electricity.

FREDERICKSBURG, VA. — The State Normal School has awarded a contract for the construction of a new two-story boiler and engine plant, about 46x100 feet, at the institution. E. G Heeflin, Law building, Fredericksburg, is the contractor.

PEARISBURG, VA. — Giles Power Company, recently incorporated with a capital of $50,000, is planning for the immediate construction of a plant to cost about $30,000, and an electric transmission system about 15 miles, connecting Pearisburg, Narrows and Glenlyn. Herbard Mason is president; I. C. Hale is secretary and manager.

FREMONT, N. C.—Bids will be received on June 27 for the purchase of $15,000 electric light bonds. Address F. B. Mayo, mayor.

COMMERCE, GA.—Bids will be received at 10 p. m., July 1, by C. A. Goodlin, city clerk and treasurer, for $15,000 electric light bonds in denominations of $500 and dated July 1, 1918.

JEFFERSONVILLE, GA. — $9000 waterworks and $6000 electric light bonds in denominations of $500 at 5 per cent have been voted. J. G. Rockmore, mayor, and A. K. Smith, secretary and treasurer.

NORTH CENTRAL STATES

CINCINNATI, OHIO. — It is reported that the Union Gas & Electric Company has under consideration the installation of a third electric generating unit.

ELKHART, IND.—H. W. Foster, mayor of this city, is operating the Jackson street car line from the outskirts of town to the business district. The Chicago, South Bend & Northern Indiana Railway Company refused to take over the line, but agreed to accept transfers. The cars are operated on a 20-minute schedule.

HUNTINGTON, IND. — DuBois County Telephone Company has increased its capital stock from $35,000 to $70,000.

RICHMOND, IND.—The city council has been asked to appropriate $55,000 for new equipment at the light plant.

GALESBURG, ILL.—The building occupied by the Delco Light Company has been extensively overhauled and repaired.

BELLAIRE, MICH. — Bonds have been voted for making extensive improvements at the electric light plant. Address village clerk.

JANESVILLE, WIS.—Rock County commissioners will install an electric light plant at the county asylum and almshouse. Address county clerk.

MONTICELLO, IOWA.—Monticello Electric Company will extend its transmission lines.

NEOLA, IOWA. — Bonds to the amount of $10,000 have been voted to improve the light and water system. Address village clerk.

ALTENBURG, MO. — Altenburg Light & Power Company has changed hands, George L. Schweitzer selling to H. J. Leimbach.

RICH HILL, MO. — Election was held recently to vote $14,000 bonds for the improvement of the city power plant.

CLAY CENTER, KANS.—A flywheel exploded here recently in the electrical lighting plant causing a damage of $40,000.

CLAY CENTER, KAS.—A flywheel electric light plant will begin just as soon as the bonds can be printed and sold.

BELVIDERE, NEB.—An issue of $7,000 electric light bonds has been approved by the state auditor.

FALLS CITY, NEB.—The state auditor has approved of an issue of $60,000 electric light bonds. Address city clerk.

LYNCH, NEB.—The sum of $7,800 in bonds has been voted for an electric light plant. Address village clerk.

SOUTH CENTRAL STATES.

DECATUR, ALA.—A company is being organized to build an electric railway from Decatur and New Decatur to Florence, Sheffield and Tuscumbia, Ala., a distance of 45 miles. Address H. L. Morrill, president.

JENIFER, ALA.—Central Alabama Coal & Iron Company is contemplating improvements to its local plant, including the installation of complete electrical equipment, machine shop, etc.

LITTLE ROCK, ARK.—Mutual Motors Company, Southern Trust building, is planning to equip a plant for rebuilding motors at an estimated cost of $50,000. Shop equipment, including battery charging outfit, air compressor, small shop tools, lathes, etc., will be required.

CHENEYVILLE, LA.—The question of issuing $16,000 light and water bonds will be submitted to a vote of the people on June 11. Address M. H. Carnahan, mayor.

POTEAU, OKLA. — Citizens Consolidated Power & Electric Company has been organized for the purpose of building a large power plant. It is proposed to furnish electricity for factories and private customers. Address manager.

SHATTUCK, OKLA.—The city has voted $55,000 water and $20,000 light bonds. Address the mayor.

STILLWATER, OKLA. — The sum of $175,000 in bonds has been voted for water, light and sewer system.

WAURIKA, OKLA. — Consumers Light & Power Company is arranging to install new electrical machinery at the Waurika plant that will double its capacity.

FORT WORTH, TEX.—The Standard Battery Manufacturing Company, which has a capital stock of $25,000, will install a plant for the manufacture of electric batteries. . J. Combs is interested.

LUFKIN, TEX.—Lufkin Electric Light & Power Company, which has increased its capital stock from $30,000 to $45,000, will enlarge its electric light and power plant. Additional machinery will be installed.

ORANGE, TEX.—The Chamber of Commerce of Orange is promoting the construction of an electric street railway system here. Plans are being made for the organization of a company to carry out the project.

WESTERN STATES.

SACO, MONT.—The municipal light plant was recently destroyed by fire. Address mayor.

CRIPPLE CREEK, COLO.—Golden Cycle Mining Company is considering plans for the erection of a large new electric power plant near its Pikeview coal mine, Colorado Springs, to cost about $200,000.

STERLING, COLO.—The council is planning to install street lights. The Colorado Power Company is reconstructing its line in Sterling and will furnish electricity. Address manager.

CALIENTE, NEV.—The installation of an electric lighting system is under consideration.

NORTHPORT, WASH.—Electric Point Company is planning for the construction of a new aerial line at its plant, about two and one-quarter miles.

OKANOGAN, WASH. — Okanogan Valley Power Company will construct a power line between Riverside and Tonasket this summer.

POWERDALE, WASH. — Pacific Power & Light Company has completed the construction of a new 66-kilowatt transmission line from its local system to a connection with the lines of the Northwestern Electric Company at its conduit plant on the White Salmon river, a distance of about seven and one-half miles. The line provides for an interchange of power between three companies—the Pacific Power & Light Company, the Northwestern Electric Company, and the Portland Railway, Light & Power Company. The line is constructed on wooden poles and crosses the Columbia river, three steel towers being provided at the latter location.

SEATTLE, WASH.—The mayor of Seattle has referred to a committee of two councilmen and Superintendent of Utilities Thomas F. Murphine the application of the Puget Sound Traction, Light & Power Company for relief from its franchise obligations during the period of the war.

SEATTLE, WASH.—Contract for furnishing labor, material, etc., for municipal elevated railway along East Marginal Way and West Spokane street,

DATES AHEAD.

National Electric Light Association. Annual convention, Hotel Traymore, Atlantic City, N. J., June 13 and 14. Secretary, T. C. Martin, 33 West 39th street, New York City.

Texas State Association of Electrical Contractors. Annual meeting, Galveston, Tex., June 15, 1918. Secretary, H. S. Ashley, Fort Worth, Tex.

Southeastern Section, National Electric Light Association. Annual meeting, Atlanta, Ga., June 19-20, 1918. Secretary-Treasurer, T. W. Peters, Columbus, Ga.

American Institute of Chemical Engineers. Summer meeting, Berlin, N. H., June 19-22. Headquarters, Mt. Madison House, Gorham, N. H. Secretary, John C. Olsen, Brooklyn, N. Y.

United States Independent Telephone Association. Annual convention, Hotel La Salle, Chicago, Ill., June 25-28. Secretary, W. S. Vivian, 19 South La Salle street, Chicago, Ill.

American Institute of Electrical Engineers. Annual convention, Atlantic City, N. J., June 26-28. Secretary, F. L. Hutchinson, 33 West 39th street, New York City.

Society for the Promotion of Engineering Education. Annual convention, Northwestern University, Evanston, Ill., June 26-29. Secretary, Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

Ohio Electric Light Association. Annual convention, Cedar Point, Ohio, July 10-12. Secretary, D. L. Gaskill, Greenville, Ohio.

National Association of Electrical Contractors and Dealers. Annual convention, Cleveland, Ohio, July 17-20. Secretary, Harry C. Brown, 101 West 40th street, New York City.

Northwest Electric Light and Power Association; affiliated with N. E. L. A. Annual convention, September 11, 1918. Secretary, George L. Myers, Pacific Power & Light Company, Portland, Ore.

International Association of Municipal Electricians. Annual convention, Atlanta, Ga., September 24-27. Secretary, Clarence R. George, Houston, Tex.

American Electric Railway Association. Annual meeting, Atlantic City, N. J., October 8 and 9. Secretary, E. B. Burritt, 8 West Fortieth street, New York City.

Kansas Public Service Association. Annual meeting, Kansas City, Kans., October 17-19. Secretary-treasurer, W. W. Austin, Cottonwood Falls, Kans.

awarded to Geske & Company, Pacific building, at $16,186.50.

SEATTLE, WASH.—Baring Granite Company, Downs building, Seattle, is to electrify its plant at Baring by installation of a 200-horsepower hydroelectric plant.

SEATTLE, WASH.—Plans for the proposed elevated electric railway are to be changed so as to afford a greater clearance of railroads both in height and width. Skinner & Eddy Shipbuilding Corporation has asked the city to construct a spur track to cost $10,000, but the permission was granted only on the condition that the company pay for constructing the spur.

SEATTLE, WASH.—The Board of Public Works has adopted a resolution favoring the Skagit power project as best for the city. On motion all bids for the development of power projects were rejected and new detail plans and specifications ordered prepared in accordance with the physical conditions encountered in the Skagit river site, conditioned on approval of this site by the city council. This is the largest of the projects which the city is considering and the capital issues commission at Washington has been asked to grant permission to issue $5,000,000 in bonds to defray expense of constructing a power plant, transmission lines, substations, etc.

TOPPENISH, WASH. — Pacific Power & Light Company has commenced the installation of a new feeder panel at its local substation for motor load control.

SEATTLE, WASH.—NePage, McKenny Company, an electrical engineering and contracting concern, Armour building, Seattle, contemplates making extensive additions to its plant. The capital of the plant will be more than doubled, bringing it up to $60,000.

SEATTLE, WASH.—Wagner Electric Company, 538 First avenue, South Seattle, has opened up a service station for taking care of starting and lighting systems.

TACOMA, WASH.—Ten street cars for the municipal line were purchased in St. Paul at $64,500 by W. G. Denny, superintendent of the city line.

WALLA WALLA, WASH.—City commissioners have ordered a survey of Mill Creek between the intake and Tiger Canyon during the coming low water season. This may mean the first step toward construction of a hydroelectric plant by the city.

GOLD HILL, ORE.—This place is to equip the McClure power plant on Rogue River for municipal light and water purposes.

PORTLAND, ORE.—Northwestern Electric Company, Pittock building, has procured a permit to erect a one-story $250,000 power plant at the foot of Lincoln street, Charles C. Moore & Company, engineers.

TOLEDO, ORE.—Notice has been filed of a change in corporate name to the Lincoln County Light & Power Company by the interests now operating the plant formerly occupied by the Thorsen-Hendricksen Company. The company is planning for the immediate installation of a 2,000-horsepower turbine and dynamo to provide for increased capacity. Electric service is furnished by Toledo and Newport.

LOS ANGELES, CAL.—The City Council is planning for the immediate installation of new ornamental lighting standards on Broadway, between First and Tenth streets, and California and First streets.

RICHMOND, CAL. — International Vegetable Oil Company is considering plans for the construction of a large plant, which will require about 300 horsepower in electric motors for operation.

SAN DIEGO, CAL. — Plans have been prepared by the San Diego Electric Railroad Company for the reconstruction of about one mile of its trackage system at East San Diego.

SONORA, CAL.—Gold Ridge Mining Company is considering plans for the immediate installation of electric equipment for the operation of its mines.

PROPOSALS

MOTOR GENERATOR SET.—The city commissioners of Newark, N. J., will receive bids July 6 for the following: One motor and generator set complete, one switchboard with controlling instrument, switchboard, etc. for motor generator set, according to plans and specifications. Morris R. Sherrerd, chief engineer.

CENTRIFUGAL PUMPS. — Bids will be received at Room 406 City Hall, Chicago, for furnishing to the city four motor-driven centrifugal sump pumps for the Twenty-second street pumping station. Address Frank I. Bennett, commissioner of Public Works.

ELECTRICAL SUPPLIES. — Bids will be received June 11 by the Commissioner of Gas and Electricity, Room 614 City Hall, Chicago, for the following electrical supplies: 1017 feet No. 2 B. & S., 600-volt, R. C. D. D. stranded copper wire, 1,017 feet 400,000 C. M., 600-volt, R. C. D. B. stranded copper wire; 290 feet S. B. & S., two-conductor, 600-volt, lead-covered cable; 3370 feet No. 8, B. & S., two-conductor, 600-volt, lead covered steel armored cable; 405 feet No. 8 B. & S., three-conductor, 600-volt, lead-covered cable; 200 feet No. 4, B. & S. three-conductor, 600-volt, lead-covered cable; 240 feet No. 2, B. & S., three conductor, 600-volt, lead-covered cable; 773 feet No. 00, B. & S., three-conductor, 600-volt, lead-covered cable; 405 feet, No. 00000, B. & S., three-conductor, 600-volt, lead-covered cable; 760 feet No. 8, B. & S., four-conductor, 5000-volt, lead-covered cable. For delivery at the Contagious Disease Hospital, Thirty-first street and California avenue: 1,000 feet, No. 00, B. & S., 600-volt, R. C. D. B. stranded copper wire; 1000 feet No. 000, B. & S. 600-volt, R. C. D. B. stranded copper wire. For delivery at the Department Storeroom, City Hall, 50,000 feet No. 14 B. & S., R. C. D. B., Duplex copper wire; 50,000 feet No. B. & S., R. C. D. B. copper wire, and 650 feet No. 8, B. & S., two-conductor, 600-volt, lead covered cable. For delivery at Chicago Dock, 663 West Chicago avenue: 12,500 feet three-conductor, No. 14 B. & S. submarine cable. William G. Keith, Commissioner of Gas and Electricity.

INCORPORATIONS

DOVER, DEL.—Arewell Corporation. Capital $2,000,000. To manufacture electrical machinery. Incorporators: M. M. Clancy, C. L. Rimlinger, and F. A. Armstrong, Wilmington.

HAMMOND, IND.—Standard Electric Engineering Company has been incorporated with capital of $100,000 to deal in mechanical and electrical apparatus. The incorporators are A. R. Stowell, George M. Chapin and Roy W. Weir.

IOWA CITY, IOWA.—Illick Electric Company has incorporated with a capital of $5,000. Address C. W. Illick.

LADORA, IOWA.—Farmers Electric Light Association has been incorporated to install and operate an electric light system.

LOUISVILLE, KY.—Articles of incorporation of the Rommel-Gosset Company, with a capital stock of $10,000, divided into shares of a par value of $50 have been filed. The new company will deal in storage batteries for automobiles and is authorized to incur liabilities not to exceed the capital stock. The incorporators are W. A. Gossett, John D. Rommel and W. A. Turner.

BROOKLYN, N. Y.—Electric Rolling Kitchen Corporation. Capital, $50,000. To manufacture electrical specialties. Incorporators, H. A. Trefethen, B. C. Sprague, and J. H. Pawling, 532 Forty-ninth street.

BUFFALO, N. Y.—Boyle & Essenwanger. Capital, $10,000. To engage in the manufacture of storage batteries, etc. Incorporators: G. P. Essenwanger, and L. M. and H. J. Boyle, Buffalo.

CAZENOVIA, N. Y.—Owahgena Telephone Company. Capital, $40,000. To operate a telephone system. Incorporators: A. B. Carpenter, H. Burden, and M. R. Joy, Cazenovia.

SPRINGWATER, N. Y.—Springwater Electric Light Company. Nominal capital, $7,500. To operate a local electric light plant. Incorporators: A. W. Howe, L. J. Hyde, and E. Robinson, Springwater.

NEW YORK, N. Y.—Technical Development Corporation. Capital, $100,000. To manufacture electrical apparatus, etc. Incorporators: F. D. Hearn, J. A. Hanway, and W. G. Chittick, 32 Broadway.

NEW YORK, N. Y.—L. R. Wood. Capital, $50,000. To engage in the manufacture of electrical apparatus. Incorporators: M. H. and L. R. Wood, and C. F. Hoffman, 49 Wall street.

NEW YORK, N. Y.—Master Telephone System, Inc. Capital, $75,000. To operate a telephone exchange. Incorporators: L. Poster, R. Carlin, and M. L. Heller, 2126 Vyse avenue.

CHILLICOTHE, OHIO.—Chillicothe & Camp Sherman Electric Railway Company, with a capital of $50,000, has been incorporated by G. A. Vaughters, John A. Poland, Alex Reuick, John P. Phillips, J. C. Martin and R. Madison.

Trade Activities

Lux Manufacturing Company Surrenders Its Premises to Government—American Fixture Demonstration in Milwakee

Electric Storage Battery Company, with general offices and works located at Philadelphia, Pa., has issued Bulletin 169, superseding Bulletin 150, which deals with its oil-switch batteries. This bulletin is well illustrated and gives electrical descriptions, showing the application of the storage batteries to switching apparatus.

Ivanhoe-Regent Works of General Electric Company, Cleveland, Ohio, has just issued Catalog No. 260, dealing with Regent bowls and shades with Rozelle color decorations applied to Veluria and Ivre glass. This catalog is gotten up in a most attractive manner and describes a line of glassware for decorative illumination which will please the most exacting tastes. In addition to detailed information concerning these bowls and shades, eight pages of the book are devoted to handsome illustrations produced in colors, and give some idea of the beautiful Rozelle color decorations applied by a special process to Veluria and Ivre glass. A price list applicable to Catalog No. 257 has also been issued by the company.

Lux Manufacturing Company, manufacturer of tungsten and nitrogen concentrated lamps at Newark, N. J., announces the surrender of its premises at the Factory Terminal building, Hoboken, N. J., to the United States Government for the benefit of the War Department. The company is now located in its new building at 123-133 East Kinney street, Newark, N. J. The new building permits an increased production of Lux lamps, and as a result the company states that customers may expect better delivery service. Factory operations were not entirely suspended, part of the plant having been installed before the Hoboken factory was closed down. The company expects to be running at full capacity within at least several weeks. Special attention is being paid to the welfare of employes at the new factory.

Cutler - Hammer Manufacturing Company, Milwaukee, Wis., has just issued a two-color folder (publication No. 252), illustrating and emphasizing the convenience of the Seventy Fifty switch. The Seventy Fifty switch is extensively used with electric irons, toasters, and other appliances as well as on the cords of electric tools for the home, office and shop. Recently the New York Tribune devoted a fourth page of a Sunday issue to the convenience and safety obtained through its use. The Tribune referred to the switch as "the last word in an electrical convenience." The Tribune Institute, which is conducted by the New York Tribune, has tested and endorsed the switch and approved it with a rating of 93 points. The Good Housekeeping Institute has also given it similar approval. The folder is furnished (with imprint) to dealers or jobbers handling C-H Seventy Fifty switches.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has distributed several new pieces of literature. Leaflet 1728 describes Type KN overload relay and its method of operation. A special feature of this product is that it is provided with a safety device which automatically trips the relay, and holds it open when the cover is removed. A cross section showing the several parts of this relay is also shown. Another leaflet deals with Type C automatic starters with counter E. M. F. acceleration. Portable hoist and dumb-waiter motors of both alternating and direct current types are described and illustrated in Leaflet 1395, and a table showing the ratings available with these motors is also given.

American Fixture Company, 232 West Water street, Milwaukee, Wis., recently conducted a scientific demonstration of efficient industrial illumination, including general factory lighting, at the Republican House in that city. This action on the part of the company aimed to educate the industries to better lighting, and representatives of industrial plants who attended the demonstration were greatly benefitted by it. The purpose of the exhibition was to point out the enormous amount of electricity wasted daily without even securing proper light and many suggestions for remedying this condition were offered. Among the features embraced by it were general and local lighting, measurement of lighting, intensities required for various kinds of work, how to eliminate objectionable shadows, effect of distance and reflectors on the consumption of electrical energy, and other features making for an effective and efficient system.

Holophane Glass Company, 340 Madison avenue, New York City, has issued booklet No. 163 entitled "Scientific Industrial Illumination." This is a book of 36 pages, very completely illustrated that gives, first, a series of pertinent reasons for the need of improved industrial illumination. Special attention is given to the following benefits resulting from it: Increased production, decreased spoilage, fewer accidents, better workmanship, 24-hour utilization of facilities and decreased labor turnover. Further discussion follows on the low cost of scientific illumination and the scientific principles of good illumination. The remainder of the book is devoted almost entirely to illustrated descriptions of Holophane reflectors and their advantages. Included in this are several types of Holophane prismatic direct lighting reflectors, Holophane indirect unit, also the combined reflector-refractor units. The book concludes with a few pages of illumination data as well as formulæ and tables of other useful engineering information, such as metric tables and equivalents, etc.

Delta Electric Company, Marion, Ind., manufacturer of electric lighting devices and specialties, announces the opening of a branch establishment at 686 Mission street, San Francisco, Cal. O. E. Yates, western sales manager for the company, has been placed in charge of the branch.

Beardslee Chandelier Manufacturing Company, Chicago, has just issued under the title "Business Building Bulletin" a 25x38-inch broadside illustrating 36 types of popular-priced direct and indirect lighting fixtures for all purposes. This broadside offers a 24-hour service on all orders for standard lighting fixtures. A new scale of discounts is also announced by this company.

The Holtzer-Cabot Electric Company, Roxbury, Boston, Mass., announces that its business in motors, dynamos, motor generators, etc., previously conducted by the James Goldmark Company, 83 Warren street, will in the future be handled from the New York office of the company located at 101 Park avenue, with Douglas Cairns in charge. From this office the Holtzer-Cabot company is prepared to give complete testing service and expert advice in the application of small motors to labor-saving machinery. Standard and special motors and dynamos for many purposes are being offered by this concern.

Leeds & Northup Company, 4901 Stenton avenue, Philadelphia, Pa., is distributing Catalog No. 20 dealing with the moving coil galvanometer. The first section of this book is devoted to a complete discussion of the moving coil galvanometer and its uses and contains a large number of charts and tables of an explanatory nature. The second part of the catalog illustrates and describes in detail an extensive line of galvanometers, lamp and scales, galvanometer mirrors, accessories, etc. A complete list of catalogs and bulletins published by the company is given, any of which will be sent upon request.

Wheeler Condenser & Engineering Company, Carteret, N. J., has just published a 28-page bulletin No. 109-B entitled "Wheeler-Balcke Cooling Towers." This bulletin shows Wheeler-Balcke cooling towers of numerous designs in capacities varying from a few thousand gallons per hour to nearly a million gallons per hour. It is shown better, in some cases, to combine natural and forced draft. Two pages are devoted to Wheeler-Barnard forced-draft cooling towers, which are at times found preferable to the Wheeler-Balcke design. Wherever sufficient ground area is available, however, the Wheeler-Balcke cooling tower is usually considered by consulting engineers as the standard natural draft tower, according to the company.

Recent Patents

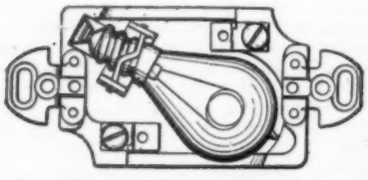
Selected and Summarized by Albert Scheible, Patent Attorney, 79 West Monroe Street, Chicago, Illinois

Insulating Material (1,262,305).—For spark plugs and the like, Albert Champion and Taine G. McDougal (both of Flint, Mich.) use a porcelain made from approximately 60 per cent plastic uncalcined clay, 10 per cent feldspar, and 30 per cent of non-plastic material comprising calcined clay and flint. The patent stands assigned to the Champion Ignition Company, of the same city.

Dynamo-Electric Clutch (1,261,594).—This is a magnetic clutch of the self-generating-current type, designed by William Morrison, of Chicago, for use on automobiles. Both the field and the armature elements revolve, and each of these elements is connected to a friction member, thus providing a friction clutch which is aided by centrifugal action.

Dynamic Balancing (1,262,593).—For determining the condition of balance of an armature or the like, Nicholas W. Akimoff, of Philadelphia, supports it by interchangeable yielding means which have predetermined natural periods of vibration under a given load, and then adjusts the supporting means to bring their vibration substantially into resonance with that of the rotating armature. The patent, covering both the method and the apparatus, was assigned to the Dynamic Balancing Machine Company, of Philadelphia.

Signal Lamp Holder (1,261,928).—The mountings for pilot or signal lights are often so cramped that they



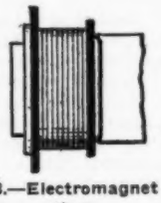
No. 1,261,928.—Compact Pilot Lamp Holder.

will not permit a standard lamp to be threaded into an ordinary socket. For such purposes, Monroe Guett, of Hartford, Conn., forms a bore in an offset metal plate which acts as a substitute for the usual screw shell of the socket. The patent stands assigned to the Hart & Hegeman Manufacturing Company.

Welding Thin Plates (1,261,943).—As a substitute for spot welding, Walter B. Lashar, of Bridgeport, Conn., uses two hollow electrodes which simultaneously bring overlapped portions of two metal pieces to a welding heat, and form interlocking cup-shaped formations on them. He thus produces a ring or eyelet weld between bosses which also interlocks mechanically so as to augment the strength of the joint.

A series of brief comments on some of the recently issued electrical patents which appear to be of particular interest to our readers, the number after each heading being that of the United States patent to which the summary relates. Any correspondence regarding such patent matters should be sent direct to Mr. Scheible at the above address.

Electromagnet (1,262,838).—A bobbin is held on the contracted tip of a magnet core between a retaining washer and a compressible spacer



No. 1,262,838.—Electromagnet Construction.

which forces the bobbin against this washer. Patent assigned by Frederick P. Poole, of La Grange, Ill., to the Western Electric Company.

Storage Battery (1,261,269).—The battery container of William Morrison of Chicago has sharply edged ribs upon its bottom, and the plates have notches on their lower edges to fit these ridges.

Drive Mechanism (1,261,748).—Where a dynamo can be pivotally suspended, as in the case of a train-lighting dynamo, either the weight of the dynamo or a spring may be used for tightening the belt running from the car axle to the dynamo. Hugo Grob, of Zurich, Switzerland, utilizes both, according to this patent, assigned to the Julius Pintsch Company, of Berlin, on an application filed in 1911. In other words, he so arranges the mounting of the dynamo that it is held in equilibrium by the tension of the belt, and then provides a spring for maintaining the belt tension constant.

Electric Rain-Alarm (1,262,391).—Details of a funnel-shaped water catcher, in which the rain will close the circuit, are shown in this patent to George A. Sabol, of Clairton, Pa.

Locking Fuse Plugs (1,262,463).—To prevent fuse plugs from being removed or exchanged, C. L. Dickson, of Chattanooga, Tenn., provides the plugs with set screws having transverse openings. He then passes a sealing wire through these openings in each pair of fuse plugs.

Switch Button (1,262,368).—To make a composite operating button for electric switches, Harold T. Martin, of New York City, takes a piece of heat-softenable material having projections on it, and places this in a mold with the projections extending upwardly. Then he superposes a mass of similar material on this piece, and applies both heat and pressure. The patent was assigned to the Western Electric Company.

Arc-Welding Apparatus (1,262,396).—For arc welding, John A. Seede, of Niskayuna, N. Y. (according to this patent, assigned to the General Electric Company) uses a resistance in series with the connections as initially made, and automatically cuts out the resistance after a certain time interval, thus limiting the heating effect of the current for a certain period.

Automatic Telephone Apparatus (1,262,639).—In this arrangement, the position of the switchhook controls two circuits, so that one is closed when the receiver is on the hook and the other when the receiver is removed. The patent issued to Henry P. Clausen, of Mount Vernon, N. Y., was assigned to the Western Electric Company.

Service-Conduit Entrance (1,263,877).—This entrance fitting, patented by Edgar H. Freeman, of Trenton, N.

No. 1,263,877.—Service-Entrance Fitting.

J., has an oblique outlet closed by a hemispherical insulating cap.

Electric Ship Propulsion (1,262,497).—According to this patent, assigned by Henry M. Hobart to the General Electric Company, polyphase alternating current produced by a turbogenerator is rectified into high-potential direct current, which is supplied to motors directly coupled to the propellers. The propeller speed is varied by varying the field strength of the direct-current motors.

Fan Support (1,263,442).—A bracket secures a small fan motor to an attaching plug which makes the electrical connections for the motor and also supports the latter. Patented by Walter L'Homadieu, of Oneida, N. Y., and James L. Brumford, of Canajoharie, N. Y.

Men in Service

A. A. Brown Promoted to Captaincy—Leigh S. Keith Commissioned—Honor Roll of Brooklyn Polytechnic Institute

BEN MCGUIRE, formerly head rate clerk in the statistical department of the Commonwealth Edison Company, Chicago, has been commissioned a captain in the Ordnance Division of the U. S. Army.

F. B. SCHLUNG, of the claim department of the Commonwealth Edison Company, Chicago, has been placed in charge of the main barracks at Camp Dewey, Great Lakes, Illinois, and is playing in the Second Regiment Band.

FORREST WINFREE, formerly auditor of the Richmond, Cal., division of the Western States Gas & Electric Company, has been promoted to first sergeant in the San Francisco Base Hospital Unit No. 47.

PROF. P. B. WOODWORTH has resigned as dean of Lewis Institute and is now district education director in the War Department. His office is located at Room 1212 Tribune building, Chicago. This district includes Wisconsin, Illinois, Indiana, Michigan and Ohio.

A. H. KUHN and J. J. NOLAN, formerly of the Chicago office of H. M. Byllesby & Company, are reported as having arrived safely overseas. This makes eight former Byllesby men from the Chicago office who are now "over there." The others are General George H. Harries, A. W. Carstens, E. K. MacDonald, R. T. Purchas, T. E. Sanford and A. H. Sayce.

A. A. BROWN, formerly sales manager of the St. Paul division of the Northern States Power Company, who received a commission as first lieutenant on completion of the Second Officers' Training Camp course, has been promoted to the rank of captain and transferred to the Seventh Division Engineers, Waco, Texas, which is expected will soon sail for France.

NORTHWESTERN ELECTRIC EQUIPMENT COMPANY, of St. Paul and Duluth, Minn., in the June number of the Northwestern Buzzer publishes its roll of honor, which bears 27 names and gives the name, military organization and present address wherever available. Of this number, one has made the supreme sacrifice, G. S. Rosness, who enlisted in the U. S. Navy, having died in the service on November 21, 1917.

LEON BROWN, eldest son of W. H. Brown, general manager of the Red River Power Company (Northern States Power Company) Grand Forks, N. D., is one of the first twenty-three Pershing fighting men to be returned to the United States on account of wounds. Young Brown was in one of the front line trenches seven days as a machine gunner. His nerves were shattered as the result of shell shock. He spent two months in a French hospital and will spend a month or more in a hospital here before being returned to the fighting lines. Mr. Brown's second son is also in France.

ROLL OF HONOR.

The electrical industry, perhaps to a greater extent than any other industry, has answered the call of the Nation for Men. As this is a war of engineers, naturally the technically trained men in the electrical industry have been in great demand and they have responded with splendid patriotism. Many of the large utility and industrial corporations have assigned men for Government service aside from those who have voluntarily entered or been called for service.

THE ELECTRICAL REVIEW *will welcome news concerning men who have entered the service or who are engaged in any patriotic duties.*

ARCHIE EVANS, for a number of years secretary to H. B. Fleming, chief engineer of the Chicago Surface Lines, was recently commissioned a first lieutenant in the construction division of the Quartermasters' Corps, National Army, and has reported for duty at Washington, D. C.

LEIGH S. KEITH, secretary-treasurer of McMeen & Miller, a well known firm of consulting telephone and electrical engineers, and secretary of the Chicago Engineers' Club, has accepted a commission as major in the Division of Statistics and Accounts recently organized under the general staff.

EDWARD BRIGGS of the Chicago office of H. M. Byllesby & Company has joined the 161st Depot Brigade, Barracks 334 West, Camp Grant, Illinois. JOHN BURMEISTER, also of the Chicago office of the company, has enlisted in Government service and is located at Camp Wheeler, Macon, Ga. C. W. PAESSLER of the same office has enlisted in the navy.

POLYTECHNIC INSTITUTE OF BROOKLYN, Brooklyn, N. Y., now carries on its roll of honor the following names of electrical engineering students: Frank E. Canavaciol, Robert Davie, William V. Drake, Edmund J. Driscoll, Samuel Ehrlich, Harry E. Estabrook, Frank J. Hammel, Reginald B. Hanford, William Harnett, Grosvenor Hotchkiss, John J. Henegan, Frederick Hirsch, Sydney K. Hopkins, Merritt Jorner, Jr., Ephraim P. Jeffe, Moses Juliber, Warren F. Johnson, Herbert W. Kells, Jerome E. Kemmerer, Frank Ledermann, Fred T. Lohr, Aaron Mandel, Arnold F. Price, Roy L. Reynolds, Robert W. Scofield, Walter J. Seeley, John S. Starrett, Burdette S. Swezey, J. Van Rensselaer Wall, Monroe G. Woolfson and Alfred W. Young.

OKLAHOMA GAS & ELECTRIC COMPANY, Oklahoma City, Okla., reports that 27 of its employes are now in Government service.

ELECTRIC-JOVIAN LEAGUE of Chicago in its bulletin lists the names of 24 members who have answered the call to the colors.

EARL I. CURRIER, formerly connected with the Parkersburg plant of the Chesapeake & Potomac Telephone Company, is now with the aero service at Camp Morrison, Virginia.

C. E. SMITH, consulting engineer at St. Louis, Mo., has received a commission as major in the engineering branch of the Quartermaster's Corps, and is stationed at Washington, D. C.

DAVID W. BRUNTON, of Colorado, who was chairman of the war committee of technical societies, the formation of which was initiated by the Engineering Council, was recently elected a member of the Naval Consulting Board.

SYDNEY S. CUNNINGHAM, formerly connected with the Richmond plant of the Chesapeake & Potomac Telephone Company, is now chief yeoman at the Naval Recruiting Station at Richmond and has been placed in charge of the pay department.

JOHN H. ENGLE, formerly of the Baltimore plant of the Chesepeake & Potomac Telephone Company, has been commissioned a lieutenant in the Three Hundred and Fourth Field Signal Battalion, stationed at Camp Meade, Maryland.

SERGEANT C. L. LEIGHTON, who was formerly a lineman of the Southwestern Bell Telephone Company at Drumright, Okla., and one of the first to answer his country's call, is now with the 473rd Aero Squadron of the American Expeditionary Forces at the front in France.

SOUTHWESTERN BELL TELEPHONE SYSTEM, St. Louis, Mo., during the month of May added 41 stars to its service flag. This makes a total of 724 stars, representing that number of employes in military service, and is a record of which this progressive company can well be proud.

SOCIETY OF AUTOMOTIVE ENGINEERS, 29 West 39th street, New York City, in the May issue of the Journal, devotes a number of pages to its roll of honor, containing the names of all members connected with the Government, either in the military service or in civilian capacities. The list contains 405 names and shows the rank, military organization and present address where available. Of this number, 266 are in military service and 139 are serving the Government in civilian capacities. Among these members are many who have earned commissions of high rank.

Personal

P. A. Staples Resigns—Alexander H. Patterson Retires—R. M. Hodgson Joins Binghamton Light, Heat & Power

J. R. DE LAMAR was elected a member of the board of directors of the National Conduit & Cable Company, of New York City, at a recent meeting.

S. B. MATSON has resigned as assistant sales manager for the Marron Electric Company, Rock Island, Ill., and has gone to New York to prepare for Y. M. C. A. service overseas.

WALTER A. FAIRSERVIS, formerly associated with James A. Donnelly, of New York, has been appointed advertising manager of the Kings County Electric Light & Power Company.

D. H. SHAPIRO has been appointed private secretary to Frank R. Coates, president of the Toledo Railways & Light Company, Toledo, Ohio. He succeeds A. H. Stocksteil who is now secretary of the Doherty Men's Club, Washington, D. C.

A. P. C. SCHRAMM, who for the past five years has served the Klaxon Company, Newark, N. J., as chief engineer, has resigned to engage in business as a consulting engineer, with offices established at 276 Canal street, New York City. His work embraces electrical, industrial and efficiency engineering.

EX-SENATOR JOHN W. SLOCUM, of Monmouth, N. J., has been elected president of the Board of Public Utility Commissioners, to succeed Lieutenant Colonel Ralph W. E. Donges, who recently resigned to accept a commission in the National Army. Colonel Donges is now a member of the War Department Board of Appraisers.

P. A. STAPLES has resigned his position as vice-president and general manager of the Binghamton Light, Heat & Power Company, Binghamton, N. Y., to become associated with Lewis A. Riley, a mechanical and gas engineer of New York City. Mr. Staples became manager of the Binghamton company late in 1916, having been just a few months previously transferred from the Sandusky Gas & Electric Company, Sandusky, Ohio, where he held the position of vice-president, to Dover, N. J., as vice-president and general manager of the New Jersey Power & Light Company.

ALEXANDER H. PATTERSON, for many years vice-president and very active in the management of the Phoenix Glass Company, Pittsburgh, Pa., has retired from business and will devote himself hereafter to personal affairs. Mr. Patterson was an efficient pioneer in the development of the use of glass for electric lighting, particularly in the manufacture of incandescent and arc light globes, and through his efforts the name of the Phoenix company has become one of the most widely known in the country. In both the electrical and gas industries, Mr. Patterson has a multitude of friends all of whom will extend cordial good wishes.

W. A. LAYMAN, president of the Wagner Electric Manufacturing Company, St. Louis, Mo., has been chosen to serve on the board of directors of Washington University.

D. C. GREEN, general manager of the Fort Smith Light & Traction Company, has been elected president of the Arkansas Association of Public Utilities for the ensuing year.

J. A. HARNETT, electrical engineer for the Western States Gas & Electric Company, Eureka, Cal., recently resigned his position to join the Southern California Edison Company.

E. B. SMITH, formerly with the Arkansas Valley Railway Light & Power Company, Pueblo, Colo., has been appointed auditor of the Muskogee Gas & Electric Company, Muskogee, Okla., succeeding J. H. Schmidt, who has resigned to engage in business for himself.

ALFRED SWEENEY, assistant general manager of the Cumberland County Power & Light Company, Portland, Me., was recently appointed general manager of the Lewiston, Augusta & Waterville Street Railway, which is controlled by the Cumberland County Power & Light Company.

J. L. FUGATE, of Salt Lake City, Utah, has associated himself with the William A. Mullins Electric Company, Tacoma, Wash., occupying the position of sales and factory manager. Mr. Fugate was formerly manager of the factory and fixture department of the Capitol Electric Company of Salt Lake City, Utah.

C. H. HOLDEN, formerly sales manager for the P R Manufacturing Company, of Detroit, Mich., has been appointed central district manager by Edwards & Company, Inc., New York City, and has established a sales office at 9 South Clinton street, Chicago. He will devote his time exclusively to the Edwards line of electrical house goods and fire alarm and signal apparatus, and will have charge of the business of the company in the Central States.

F. M. HAWKINS, a pioneer in the switchboard and panelboard business and one of the founders of the Crouse-Hinds Company, Syracuse, N. Y., has retired as New York manager of this organization to devote his time to personal interests. Mr. Hawkins entered the electrical field in 1883 and in the early days assisted in the construction and installation of many plants. In 1889 he began his career as a salesman, selling electrical supplies for the old Electrical Engineer & Sunply Company, of Syracuse. Mr. Hawkins is widely known among electrical supply and construction men throughout the United States and Canada, and the termination of his 24 years' management of the New York branch of the Crouse-Hinds Company will be of general interest to the trade.

N. C. DRAPER, manager of the Northern States Power Company, Sioux Falls division, has been elected a member of the executive board for the South Dakota Electric Power Association for the ensuing year.

SAMUEL KAHN, general manager of the Western States Gas & Electric Company, with executive offices at Stockton, Cal., has been elected president of the Pacific Coast Section of the National Electric Light Association.

W. E. HEWITT, formerly connected with the municipal light and water works of Douglasville, Ga., was recently appointed superintendent of the municipal water and light plant at Sandersville, Ga., succeeding to the position of L. J. Porter.

C. H. DAVIS, general superintendent of the Marlboro Electric Company, Marlboro, Mass., and manager of the Westboro Gas & Electric Company, Westboro, Mass., was recently appointed manager of the Westfield municipal gas and electric light works.

E. R. SHEPARD, associate electrical engineer in the Bureau of Standards, Washington, D. C., was a recent speaker before the Urbana section of the American Institute of Electrical Engineering and the Electrical Engineering Society of the University of Illinois. His topic was "The Work of the Bureau of Standards."

S. H. GRAUTEN has been appointed electrical engineer of the Kansas City Railways, Kansas City, Mo., his duties covering the design, construction and operation on the substations and electrical distribution system. This work includes the rehabilitation started about a year ago and under which three substations have been completed and will soon be placed in operation.

R. M. HODGSON, formerly associated with the Philadelphia office of the General Electric Company, has been elected a director and the vice president and general manager of the Binghamton Light, Heat & Power Company, Binghamton, N. Y., to succeed P. A. Staples. Mr. Hodgson has also been elected the second vice president and general manager of the Sayre Electric Company. He will have complete charge of operation of both companies.

HUGH H. HARRISON, president of the Merchants Heat & Light Company, of Indianapolis, Ind., since 1914, has resigned his position, effective at once. Mr. Harrison was born in Indianapolis but gained most of his business experience with utility companies in various fields. He has served in an operating or in a financial capacity at various times with the J. G. White Company, the Pullman Company and other corporations. He has made no announcement regarding his future, but will retain his residence in Indianapolis for the present.

Financial News

Local Commissions Urged to Aid Utilities.

In a statement recently made by the directors of the War Finance Corporation, local authorities throughout the country were urged to give prompt attention to applications of public utility companies for rate increases.

"The directors of the corporation feel," says the statement, "that the localities served by these various public utility enterprises should not expect the War Finance Corporation to make advances to any utility company whose statement shows that it is in actual need of increased revenue.

"It is a matter for the local authorities to determine whether or not an increase in rates sufficient to maintain the enterprise as a going concern should be granted. It is urged, therefore, that the proper authorities give prompt consideration to applications made by public utilities for permission to increase rates, in order that the directors of the War Finance Corporation may know when applications for loans are presented by public utility corporations whether or not they will be able to give adequate security."

Springfield Railway & Light to Issue Bonds.

The Springfield Railway & Light Company, which controls the Springfield Consolidated Railway Company, has asked authority from the Illinois Public Utilities Commission to issue two blocks of 5 per cent gold bonds, one block for $75,500, and the other for $107,000. The total amount of $182,500 is needed to pay notes given by the company since December 31, 1913, these notes representing improvements of a permanent nature which have enhanced the value of the property. These betterments include seven street cars for the Fifth street line costing $49,000, the extensions and the turns built at either end of the Fifth street line, the building of the line to Bergen Park, the extension of gas mains, the installation of gas meters and the improvements in the company's facilities for producing and selling electric lighting and power service. The Commission will conduct an appraisement upon the property of the company invested in the street railway and the electric lighting and power service. The appraisement on the gas service has already been made.

Annual Report of Montreal Light, Heat & Power Company.

The annual report of the Montreal Light, Heat & Power Consolidated Company for the fiscal year ended April 30 is the first full 12 months' statement under the existing corporation organization, the report of a year ago having been for a nine months' period dating from the merger with the Cedar Rapids Power Company.

Gross earnings in the past year were $10,390,684. After expenses, taxes and depreciation and renewals, reserves amounting in all to $5,806,937, net revenue amounted to $4,583,746. After fixed charges the net income was $3,588,723, while surplus after dividends of $2,556,025 was $1,032,698. After appropriating $20,000 to the pension fund there was transferred to the pension fund there was transferred to general surplus account $1,012,698. Total assets of the company are $75,- assets. This contrasts with current liabilities amounting to $3,307,807. The surplus account amounts to $1,585,313.

Duquesne Light Company to Issue Bonds.

A meeting of the stockholders of the Duquesne Light Company will be held July 29 to authorize the issuance of $25,000,000 25-year 6 per cent bonds. These will be secured by a mortgage on all the property and franchises of the company, of which $15,000,000 will be used as collateral to secure the proposed issue of $120,000,000 three-year 6 per cent notes.

Milwaukee Electric Notes.

A syndicate composed of Spencer Tracy & Company, Harris, Forbes & Company, Coffin & Company, of Boston, Wisconsin Trust Company and the First National Bank of Milwaukee, has purchased $2,000,000 two-year 7 per cent secured notes of the Milwaukee Electric Railway & Light Company, dated May 1, 1918, and maturing May 1, 1920. A public offering of the notes will be made at 98½ in the immediate future. These notes are a general obligation of the Milwaukee Electric Railway & Light Company, and are additionally secured by deposit to the trustee of $3,000,000 general and refunding mortgage 5 per cent bonds.

New Orleans Railway & Light Asks for Note Extension.

D. D. Curran, president of New Orleans Railway & Light Company, has sent out a notice to the holders of the $4,000,000 of two years 6 per cent debentures, due June 1, 1918, asking for an extension of time to pay the principal. In his letter Mr. Curran says, in part: "We regret to advise you that, greatly to our surprise, after hearings of over a period of ten days before the War Finance Corporation at Washington, that board suddenly issued a ruling to the effect that the resources of the War Finance Corporation are not intended to be loaned directly to war industries, but only indirectly, through the banks. This company is, therefore, compelled to ask the holders of the 6 per cent gold debentures maturing June 1, 1918, to consent to an extension of the principal. Interest will be paid on presentation of coupons. In the hearings the company's showing was apparently very satisfactory and this is further evidenced by the War Finance Corporation's engineer's report on the physical property, the condition in which it is maintained and its relationship with the public authorities and its patrons."

Earnings of Federal Sign System Show Decrease.

The annual report of the Federal Sign System (Electric) for the year ended March 31, 1918, shows a further decrease in earnings. The return for the year was equal to a fraction better than 3 per cent on the $2,059,300 preferred stock, against 4.81 per cent the previous year, which latter showed a loss from 1916.

Samuel Insull, chairman of the board of directors, ascribed the decrease in the fiscal year just ended to the effect of the fuel saving orders "limiting and to some extent prohibiting the use of electric signs and displays, which has been very serious, especially during the winter months, which ordinarily are the most profitable of the year." It is believed, however, that if no further governmental regulations detrimental to the company's business are enacted during the coming year the situation during the current fiscal year will be much improved. The income and balance sheet, with comparisons, follow:

INCOME ACCOUNT.

Year ended March 31—	1918.	1917.
Income from all sources	$2,136,540	$2,355,217
Expenses (including depreciation)	2,074,481	2,254,042
Net income	$ 62,059	$ 101,175

ASSETS.

	1918.	1917.
Property, patents, etc.	$5,084,628	$4,487,192
Investments	194,672	159,110
Current assets	1,031,464	1,078,492
Deferred charges	472,464	522,230
Totals	$6,783,228	$6,607,124

LIABILITIES.

Preferred stock	$2,059,300	$2,059,300
Common stock	3,258,400	3,108,400
Current liabilities	687,136	782,322
Reserves	413,599	348,068
Surplus	364,792	309,034
Totals	$6,783,228	$6,607,124

Union Electric Light & Power Increases Stock.

Union Electric Light & Power Company has increased its capital stock from $21,240,000 to $22,240,000. The million dollar increase was made by issuance of 10,000 shares of common stock at $100 par. The statement says the new stock is 50 per cent paid up. Present assets of the company are listed at $40,780,647, and liabilities, including capital stock, are $38,875,830.

Interborough Rapid Transit Seeks Loan from Government.

The Interborough Rapid Transit Company has made formal application to the War Finance Corporation in Washington for a loan of $37,700,000 for three years. It is proposed to secure this loan with $39,489,000 of first and refunding mortgage 5 per cent bonds of the company which are now held in the treasury, permission for the issuance of which already has been granted to the company by the Public Service Commission. At the time the Public Service Commission granted this permission to the corporation several months ago it stipulated that the bonds should not be sold at less than 93½. Had the bonds been immediately put out that price could have been realized, but, as a matter of patriotism, the management held up the offering because it would have conflicted with the first offering of Liberty Loan 3½ per cent bonds. The feeling was that after the Liberty Loan campaign was over the market would be such as to permit sale of these bonds at not less than the figure mentioned. The situation in the investment markets, however, changed decidedly in the meantime and this prevented the sale of bonds by any corporation except at prohibitively low prices.

Dividends.

The board of directors of the American Public Service Company has declared a quarterly dividend of 1¾ per cent on preferred stock, payable July 1 to stockholders of record June 15.

Muskogee Gas & Electric Company has declared the regular quarterly dividend of 1¾ per cent on preferred stock, payable June 15 to stock of record May 31.

Arkansas Valley Railway, Light & Power Company has declared the regular quarterly dividend of 1¾ per cent on preferred stock, payable June 15 to stock of record May 31.

Oklahoma Gas & Electric Company has declared the regular quarterly dividend of 1¾ per cent on preferred stock, payable June 15 to stock of record May 31.

Chicago Telephone Company has declared a quarterly dividend of $2 a share, payable June 29 to stock of record June 28.

Consolidated Traction Company of New Jersey has declared a semi-annual dividend of 2 per cent, payable July 15 to stock of record June 29.

New York Edison Company has declared the regular quarterly dividend of 1¾ per cent, payable June 14.

Standard Gas & Electric Company has declared the regular quarterly dividend of 1½ per cent on preferred stock, payable June 15 to stock of record May 31.

Indianapolis Street Railway Company has declared a dividend of 3 per cent, payable July 1 to stock of record June 21.

Worthington Pump & Machinery Corporation has declared the regular quarterly dividend of 1¾ per cent on its preferred "A" stock, and 1¼ per cent on its preferred "B" stock, both payable July 1 to stock of record June 20.

Earnings.

REPUBLIC RAILWAY & LIGHT COMPANY.

	1918.	1917.
April gross	$ 463,035	$ 368,125
Net after taxes	139,820	127,856
Surplus after charges	41,396	47,430
12 months' gross	5,297,194	4,183,498
Net after taxes	1,691,064	1,644,093
Surplus after charges	617,501	762,344

NEVADA - CALIFORNIA ELECTRIC CORPORATION.

Combined comparative statement of earnings and expenses of the Nevada-California Electric Corporation and subsidiary companies, after eliminating intercompany transactions, for the month of March and three months ending March 31, are as follows:

	1918.	1917.
March gross	$ 171,009	$ 143,150
Net after taxes	89,387	84,954
Surplus after charges	14,391	27,213
3 months' gross	489,022	400,781
Net after taxes	265,144	220,626
Surplus after charges	49,547	56,296

CLEVELAND ELECTRIC ILLUMINATING COMPANY.

The Cleveland Electric Illuminating Company shows increases in gross and net earnings and for the four months ended April 30, 1918, net revenues of $949,701 were equivalent to about one and one-quarter times the full year's interest requirements.

ILLINOIS TRACTION COMPANY.

Statement of earnings of the properties controlled by the Illinois Traction Company for year ended December 31, 1917, compares as follows:

	1917.	1916.
Gross earnings	$14,040,870	$12,566,447
Balance after expenses and taxes.	4,891,694	5,076,649
Surplus after charges	1,076,728	902,384
Preferred dividends.	432,750	428,130
Common dividends .	368,732	367,584
Balance	275,246	106,670

TWIN CITY RAPID TRANSIT COMPANY.

	1918.	1917.
April gross	$ 776,967	$ 839,072
Net earnings	221,755	304,625
Surplus after charges	66,194	159,223
4 months' gross	3,234,357	3,480,984
Net earnings	798,055	1,147,078
Surplus after charges	176,365	566,607

VIRGINIA RAILWAY & POWER COMPANY.

The Virginia Railway & Power Company reports for April:

Gross earnings	$ 642,520
Operating expenses	358,755
Net earnings from operating	283,764
Other income	13,881
Total income	297,646
Taxes, licenses, interest, sinking fund, etc.	162,643
Net earnings (before depreciation)	135,002
From July 1:	
Gross earnings	$6,098,986
Operating expenses	3,319,513
Net earnings from operating	2,779,473
Other income	100,708
Total income	2,880,181
Taxes, licenses, interest, sinking fund, etc.	1,597,868
Net earnings (before depreciation)	1,282,313

BOSTON SUBURBAN ELECTRIC COMPANIES.

Boston Suburban Electric Companies report for year ended December 31, 1917, compares:

	1917.	Year ended June 30, 1916.
Income from securities.	$ 114,952	$ 146,333
Expenses and interest	59,193	50 288
Net income	*55,759	96,045
Preferred dividend	41,203	93,793
Surplus	24,556	2,252

*Equal to $1.79 on 31,203 shares of preferred stock, against $3.07 in 1916.

NORTHERN ONTARIO LIGHT & POWER COMPANY.

The Northern Ontario Light & Power Company's gross earnings for the first quarter of 1918 were $230,212, an increase of $10,372 over the corresponding quarter of 1917. Net earnings amounted to $171,458, compared with 169,444 for the same period of the year before.

CITIES SERVICE COMPANY.

For April—	1918.	1917.
Gross earnings	$1,885,750	$1,609,013
Net earnings	1,848,497	1,578,125

DETROIT EDISON COMPANY.

	1918.	1917.
Gross revenue	$1,090,297	$ 977,668
Net revenue	300,319	303,160
Balance after deducts.	198,422	218,427
For four months—		
Gross revenue	4,650,850	4,166,105
Net revenue	1,367,290	1,457,472
Balance after deducts.	973,895	1,117,796

SOUTHERN CALIFORNIA EDISON.

Gross revenue and operating expense affected by change in May, 1917, from retail to wholesale basis in Los Angeles:

	1918.	1917.
March gross	$ 598,871	$ 688,985
Net after taxes	361,830	410,795
Surplus after charges	117,827	220,776
12 months' gross	8,078,417	8,403,068
Net after taxes	5,210,318	5,053,009
Surplus after charges	2,633,176	2,790,153

Combined earnings of Southern California Edison Company and controlled companies:

	1918.	1917.
12 months' gross	$9,861,680	$9,856,882
Net after taxes	5,838,321	5,637,551
Surplus after charges	2,700,823	2,996,310

REPUBLIC RAILWAY & LIGHT.

The Republic Railway & Light Company and subsidiary company report for April is as follows:

Gross earnings	$463,035
Net income	41,396
Balance	15,439

WESTERN UNITED GAS & ELECTRIC COMPANY.

The annual report for the fiscal year ended January 31 last shows gross earnings of $1,830,436, compared with $1,605,236 for the preceding year. Net after taxes totalled $702,080, an increase of $34,205 over the year before. Surplus for the year amounted to $387,414, against $354,582 for the previous year, an increase of $32,831.

NORTHERN STATES POWER COMPANY.

Gross and net earnings of Northern States Power Company for the month of April and for the year ended April 30 are reported as follows, compared with corresponding periods a year ago:

Month of April—	1918.	1917.
Gross earnings	$ 637,056	$ 550,325
Net earnings	279,192	286,374
Year ended April 30—		
Gross earnings	7,507,603	6,428,124
Net earnings	3,262,272	3,420,509

COLORADO POWER COMPANY.

	Gross earnings. 1918.	1917.	Net earnings. 1918.	1917.
March	$ 103,461	$ 93,517	$ 59,215	$ 53,102
12 months	1,222,036	1,084,295	699,644	604,448

UTAH SECURITIES CORPORATION SUBSIDIARIES.

	Gross earnings. 1918.	1917.	Net earnings. 1918.	1917.
April	$ 561,285	$ 526,223	$ 313,935	$ 296,806
12 months	6,846,966	5,914,784	3,651,370	3,276,411

WESTERN UNION TELEGRAPH COMPANY.

	Gross earnings. 1918.	1917.	Net earnings. 1918.	1917.
March	$ 7,197,029	$ 6,095,305	$1,946,873	$2,120,279
3 months	20,160,690	16,875,129	5,044,193	5,601,070

WEEKLY COMPARISONS OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeller & Co., Rookery Bldg., Chicago.

Public Utilities—	Div. rate. Per cent.	Bid May 28.	Bid June 4.
Adirondack Electric Power of Glens Falls, common	6	12½	12½
Adirondack Electric Power of Glens Falls, preferred	6	71	71
American Gas & Electric of New York, common	10+extra	88	88
American Gas & Electric of New York, preferred	6	40	40
American Light & Traction of New York, common	..	191	190
American Light & Traction of New York, preferred	6	96	96
American Power & Light of New York, common	4	40	40
American Power & Light of New York, preferred	6	68	68
American Public Utilities of Grand Rapids, common	..	..	..
American Public Utilities of Grand Rapids, preferred	6	..	..
American Telephone & Telegraph of New York	..	98	97½
American Water Works & Elec. of New York, common	..	4¾	4¾
American Water Works & Elec. of New York, particip	7	13	13
American Water Works & Elec. of New York, first preferred	..	57	57
Appalachian Power of Bluefield, common	..	3	3
Appalachian Power of Bluefield, preferred	7	20	20
Cities Service of New York, common	+extra	211	213
Cities Service of New York, preferred	6	74¾	74¾
Commonwealth Edison of Chicago	8	102	101
Comm. Power, Railway & Light of Jackson, common	..	21	21
Comm. Power, Railway & Light of Jackson, preferred	6	46	45
Federal Light & Traction of New York, common	..	3	3
Federal Light & Traction of New York, preferred	..	26	26
Illinois Northern Utilities of Dixon	6	..	..
Middle West Utilities of Chicago, common	2+extra	15	15
Middle West Utilities of Chicago, preferred	6	..	..
Northern States Power of Chicago, common	ex.div.7	44	44
Northern States Power of Chicago, preferred	ex.div.7	85	85
Pacific Gas & Electric of San Francisco, common	..	33	33
Pacific Gas & Electric of San Francisco, preferred	6	80	80
Public Service of Northern Illinois, Chicago, common	7	73	73
Public Service of Northern Illinois, Chicago, preferred	6	86	86
Republic Railway & Light of Youngstown, common	4	22	22
Republic Railway & Light of Youngstown, preferred	6	58	58
Standard Gas & Electric of Chicago, common	..	4	4
Standard Gas & Electric of Chicago, preferred	6	25	24½
Tennessee Railway, Light & Power of Chattanooga, common	..	2	2
Tennessee Railway, Light & Power of Chattanooga, preferred	6	9	9
United Light & Railways of Grand Rapids, common	4	30	30
United Light & Railways of Grand Rapids, preferred	6	64	63
Western Power of San Francisco, common	..	12	12
Western Power of San Francisco, preferred	6	49	49
Western Union Telegraph of New York	extra	90	89½
Industrials—			
Electric Storage of Philadelphia, common	4	49	48½
General Electric of Schenectady	8	146	146
Westinghouse Electric & Mfg. of Pittsburgh, common	+extra	41	41
Westinghouse Electric & Mfg. of Pittsburgh, preferred	7	58	58

*Last sale.